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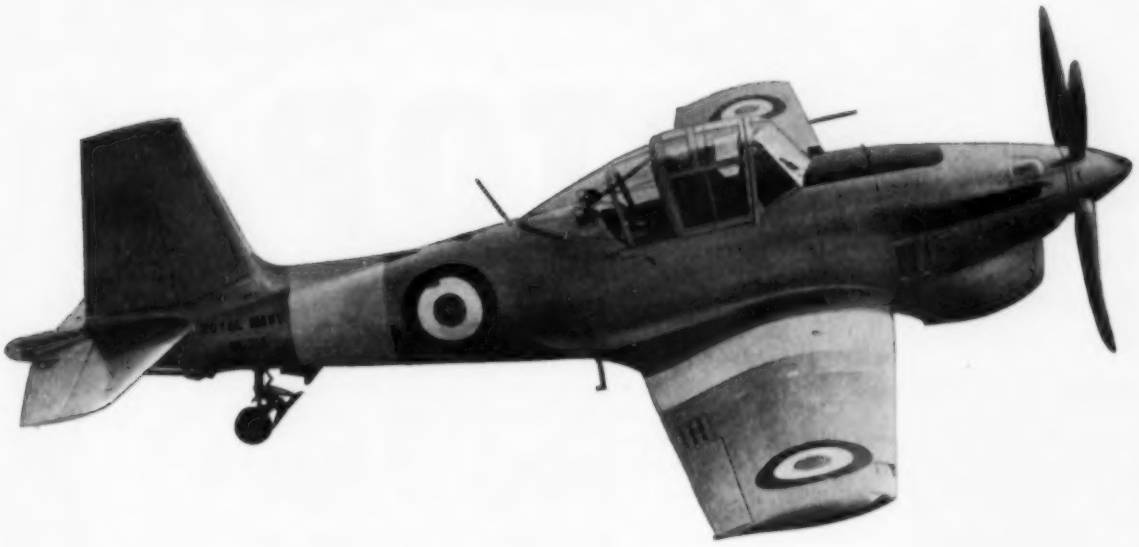

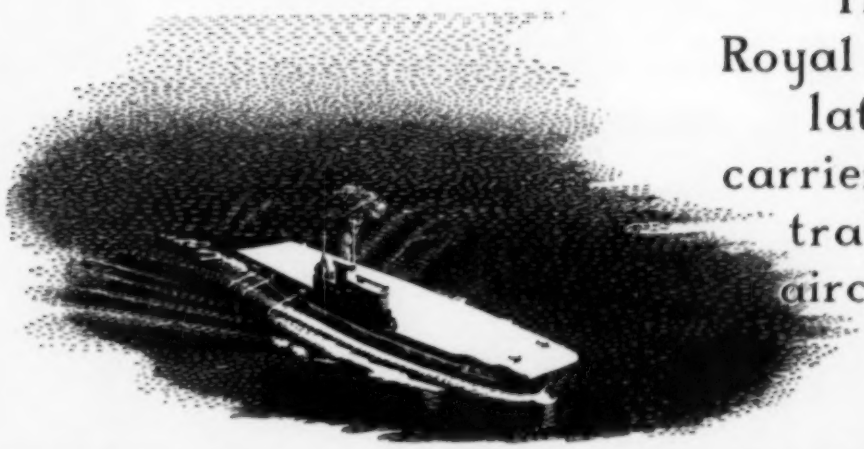

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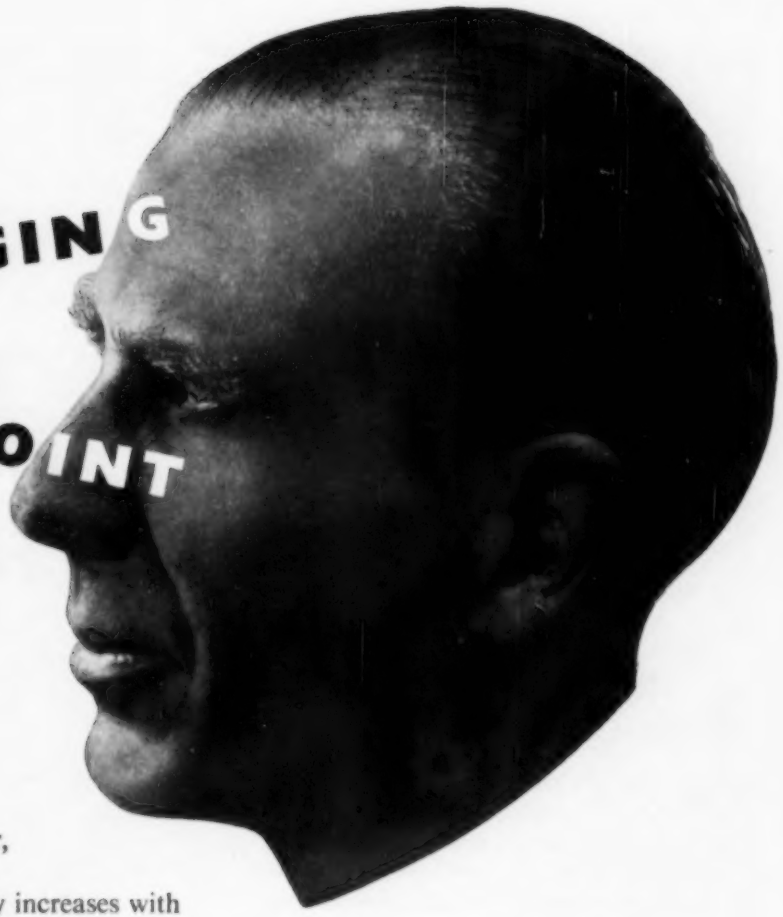

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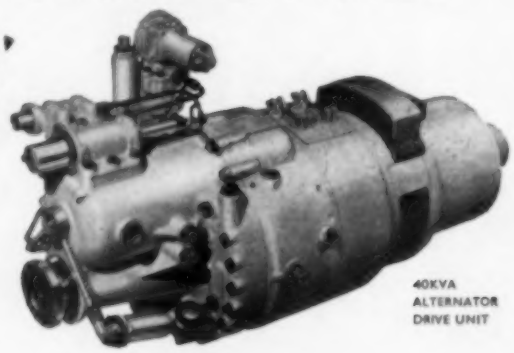

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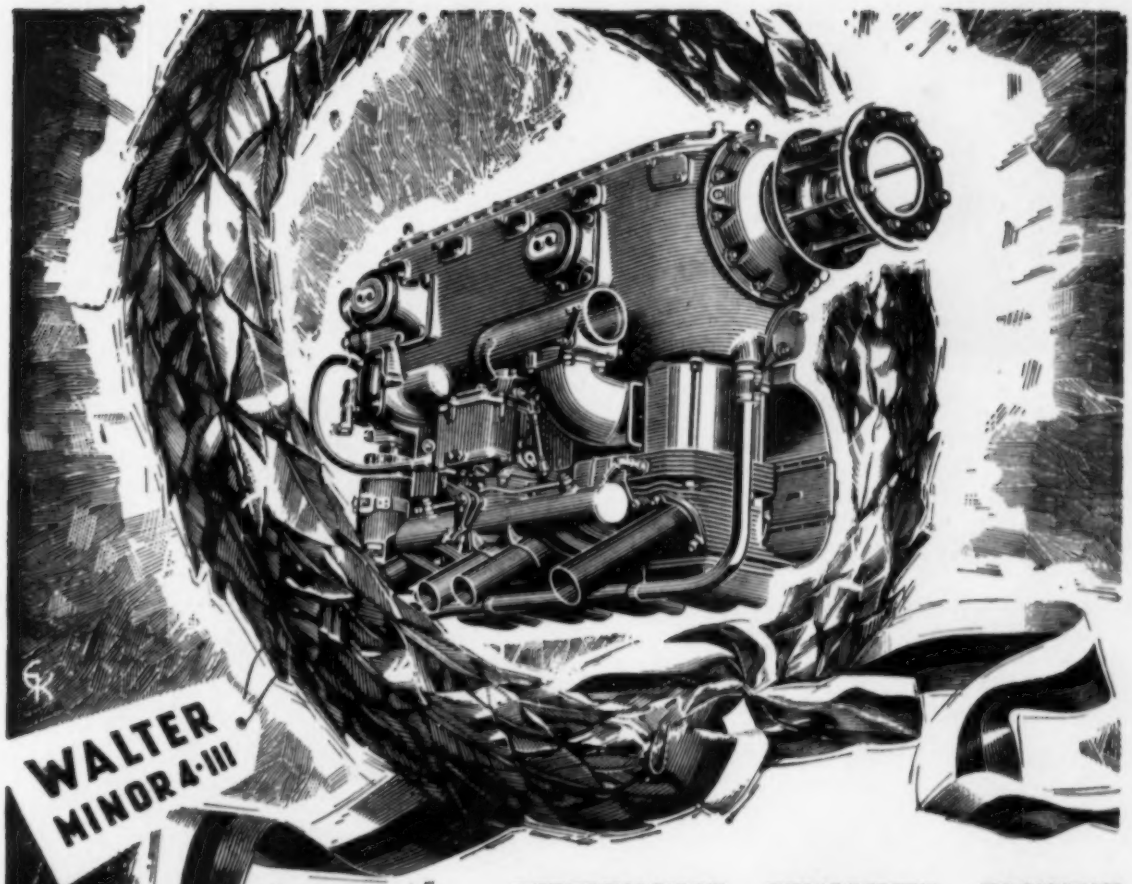

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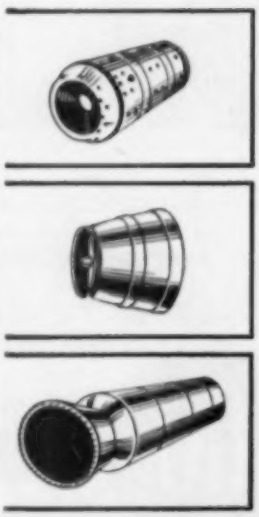

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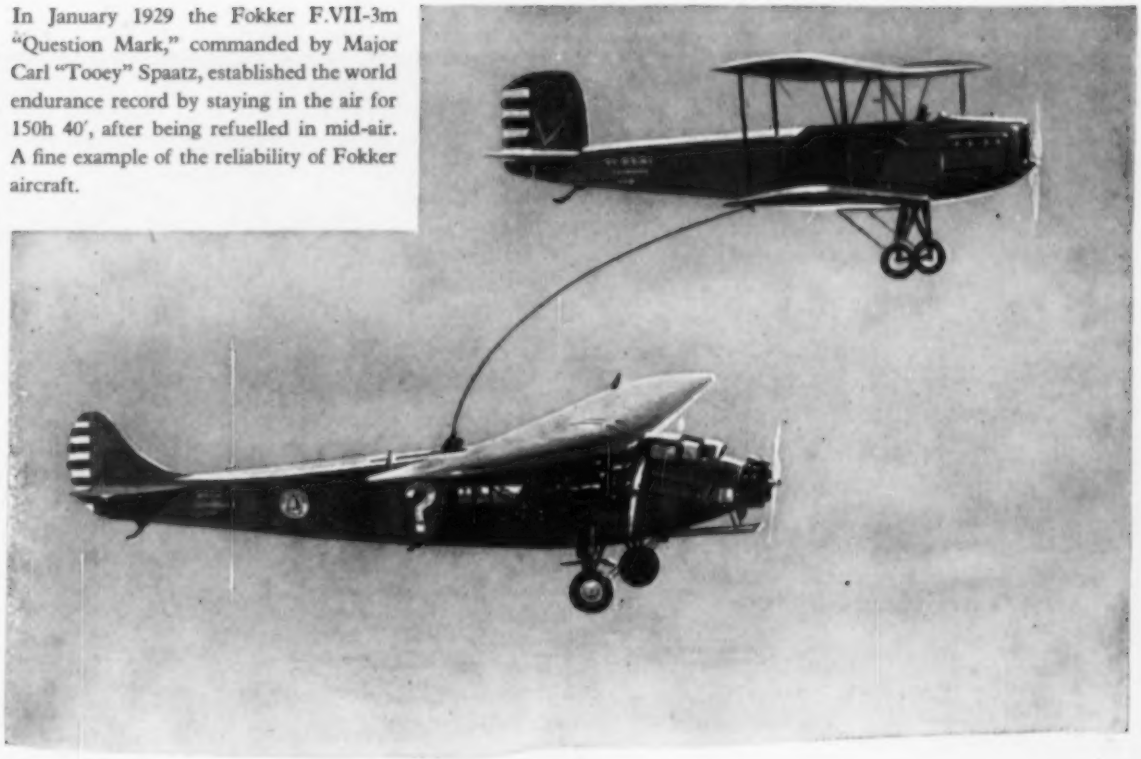

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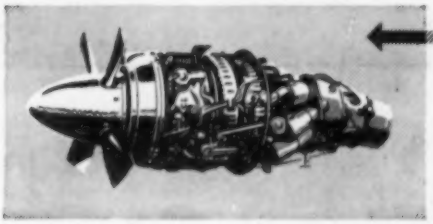

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AIRCRAFT ENGINEER

First Aeronautical Weekly in the World

Founded 1909

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The Helicopter in the Making

UNLIKE most newly introduced vehicles and machines, the helicopter has been received more readily by the public than by the engineers of the industry in which it was conceived. It has undoubtedly captured the people's imagination, and it has done so by its unique ability to perform tasks beyond the capability of any other type of craft. The rotating-wing aircraft has a strong appeal, too, by reason of the fact that in some situations, e.g., on certain short-haul routes, it promises to provide a method of avoiding one of the drawbacks of fixed-wing air transport, namely, the trying and noisy process of take-off along a mile or more of concrete, and the almost equally unsatisfactory procedure involved in landings.

The use of helicopters—and small single-engined ones at that—by the Royal Family has removed from the public mind many lingering doubts about the reliability of such machines; yet—and to revert to our opening theme—several of the country's leading aircraft-manufacturing organizations, among them de Havilland, Handley Page, the Hawker Siddeley group, and Vickers, have yet to show tangible interest in helicopters. In saying this we cast no reflection upon these great companies, because it is well known that they are fully occupied in other directions; in addition, *Flight* has commented in the past upon the undesirability of over-stretching and over-diluting the very few technical staffs that have helicopter experience.

With those who continue to maintain that the helicopter is an unsatisfactory device, "a perfect machine for demonstrating the effects of fatigue," and so forth, we are inclined to agree less each day.

Extra-mural Possibilities

The apparent lack of interest in helicopters by large aircraft companies—and our remarks apply even more forcefully to the American aircraft industry, and to some extent to France—may turn out to represent a largely unconscious foreshadowing of the future. There are those who believe that helicopters differ from fixed-wing aircraft to such an extent that they could be built with advantage outside the aircraft industry. There is some sense in this argument. Certainly mechanical-type helicopter designs—those with gear- and shaft-driven rotors—seem to owe only a very small part of their success to fixed-wing manufacturing experience; their slab-sided, tubular-framed bodies and the engine, clutches, gearboxes and even control mechanisms all represent detail work of a type handled daily outside the aircraft industry as such. This line of thought applies with less force to tip-jet designs; but these represent entirely new ground even to the aircraft design teams.

We ourselves do not rule out the possibility of certain classes of small helicopters being built cheaply and in large numbers by firms hitherto unconnected with flying, though in this case rotor heads and blades may have to be bought or "borrowed." We include here the small tip-jet types that are likely to be used by the Army for communications and spotting. These machines will in any case have to be handled by M.T. sections, much as if they were motor bikes.

For the larger rotating-wing machines—especially the helibuses of a decade hence—we prefer to think in terms of the experience and exceptionally high standards for which the aircraft industry is famed. This may mean higher costs and longer to wait, but it is our guess that the additional safety and reliability which follow will provide the justification. To achieve this end, however, British manufacturers will have to expand their facilities, attract and train hundreds of new men, spend a great deal more money and accept that their helicopters will still make little progress—either at home or competitively with those produced abroad—if they are treated only as a sideline.

FROM ALL QUARTERS

Minister's Statement on Javelin

A STATEMENT on the production and delivery of the Javelin was made in the House of Commons last Monday by Mr. Reginald Maudling, Minister of Supply. He recalled that on March 2nd the Minister of Defence had stated that, on the best technical advice, the reasonable expectation was that the Javelin would become available in substantial numbers in the coming financial year. Since then, further progress had been made with the development programme to which the Minister of Defence referred; Mr. Maudling said he had no reason to depart from that estimate.

It had now been decided, continued the Minister, to reduce the number of Javelins of the earlier marks and order more of the later marks—a change which the R.A.F. were satisfied would be to their advantage. The number of aircraft in the order would be the same and delivery would be for the same period of time.

Mr. Charles Ian Orr-Ewing (Con., Hendon North) asked if it was not a fact that delays in this aircraft were exceptional because so few prototypes had been ordered by the last Labour Government. Adding that there were exceptional delays in other types of aircraft as well, he asked the Minister if he would consult with his predecessor (Mr. Duncan Sandys) to see what steps could be taken to avoid delays.

Mr. Maudling replied that he was consulting his predecessor. It was certainly true that there had been three crashes of Javelin prototypes and there was no doubt that if more prototypes had been ordered development would have been quicker.

Questions were then asked about the general position regarding production and development of aircraft ordered by the M.o.S.

Mr. Maurice Edelman (Lab., Coventry North) inquired as to the sums expended by the Department on aircraft development and production contracts during the past three years. Mr. Maudling said that the figures for expenditure on the production of airframes, aero engines, and spares, were, respectively, £129m, £161m and £210½m. It was not the practice, he added, to give figures for research and development.

Mr. Edelman then asked what types of aircraft originally ordered by the Ministry had been discontinued in manufacture during the last three years and what was the value of contracts thus cancelled. Mr. Maudling said that a total of £70m was involved, representing the cancellation of contracts for a variety of types, including four marks of Meteor, two marks of Venom, and one mark of Balliol, Vampire, Canberra, Varsity, Dragonfly and Firefly. He added that all further orders for the earlier marks of Swift had been cancelled, the orders for the Mk 4 reduced and orders for the Mk 6 cancelled.

F.A.I. Golden Jubilee Conference

THE 48th general conference of the Fédération Aéronautique Internationale, which concluded recently in Paris, was of unusual importance in view of the fact that this year marks the golden jubilee of the F.A.I. At the inaugural meeting, presided over by General Corniglion Molinier, French Minister of Public Works and Transport, the F.A.I. medals and diplomas were presented—the Lilienthal Medal for gliding to Mr. Philip Wills, and the Louis Blériot Medal for a 100-km closed circuit record in a light aircraft to the Italian, Iginio Guagnellini. Among the recipients of Paul Tissandier diplomas were Dr. S. G. Hooker, Mr. D. A. Gordon, Mr. Philip Wills, and Col R. L. Preston. The F.A.I. Gold Medal had already been presented to Gen. Doolittle.

The meeting noted that private and sporting aviation had been subjected to more and more restrictive legislation and it was stated that efforts would be made to have such measures reduced. Problems of club and aircraft management and technical questions were also dealt with. A standing committee was elected to look after all questions affecting rotary-wing aircraft. Capt. K. J. G. Bartlett was re-elected for a second year as president and Vienna was chosen as the location of the 1956 general conference. Among the amendments made to record regulations was the introduction of records for (a) speed of climb, and (b) loads carried to height by aircraft taking off from aircraft carriers. Duration records for gliders are being discontinued on the grounds of safety.

The secretary read a report on club aviation during 1954 covering all member nations of the F.A.I. It showed a relatively stable situation, with slight variations in the number of clubs, club aircraft, and privately owned aircraft in the various countries. In expansion of club activity, England led with seven new clubs formed during 1954.

Records in all classes totalled 71, Italy leading Europe with nine. In the East, Russia gained 37, 29 of them for parachuting.

GRACIOUS ACCEPTANCE of a model of a hypothetical supersonic aircraft by Her Royal Highness Princess Margaret at the R.A.E. Golden Jubilee celebrations. Veteran employee Charles Wilshire makes the presentation; Sir Arnold Hall, Director of the Establishment, looks on. A report of the presentation appears on page 74.

AIR TO AYR: This fine study of Scottish Aviation's new Twin Pioneer shows it on test over its home town of Prestwick, with St. Nicholas Golf Course and the River Clyde as background. Appropriately registered G-ANTP, it was described in detail in "Flight" of March 18th.

TEXAS RECRUIT: Now under development for the U.S. Army at the Bell helicopter division at Fort Worth, the XH-40 promises to be particularly neat. Seemingly turbine-powered (probably by a Continental T51), it will cruise at over 100 kt with 800 lb of useful load.

TANDEM TRANSPORT: Described on page 35 of last week's issue, the Piasecki PH-42 civil derivative of the H-21 Work-Horse helicopter is intended for delivery in 1956. The built-in steps are noteworthy; the power unit will be a Wright R-1820 of 1,425 take-off h.p.

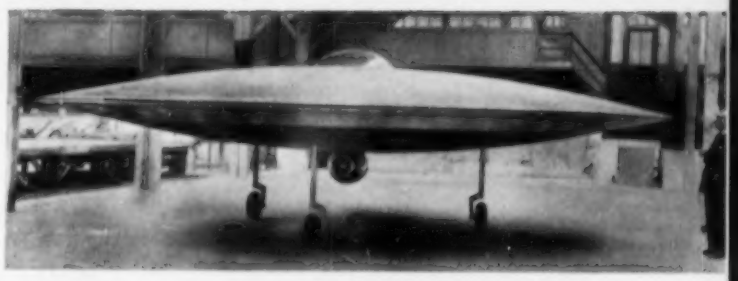
A New Canberra

MENTION may now be made of the English Electric Canberra P.R.9, which has been specifically designed for long-range photo-reconnaissance at extreme altitudes. Ordered in quantity for the R.A.F., the Mk 9 has more powerful Rolls-Royce Avons, a wing of increased chord inboard of the engines and four feet more span (to 68ft). Production Mk 9s will have a "Mk 8 type" canopy, but this is not fitted to the prototype, first flown last Friday by Mike Randrup, the Napier test pilot. Napiers (a member of the English Electric group) did detail design and built the prototype, basic research having been done at Warton.

Loss of the "525"

THE prototype Vickers-Supermarine 525 crashed and caught fire at Idmiston, near Salisbury, on July 5th. Its pilot, Lt-Cdr. Anthony Rickell, who was flying the aircraft from the A. and A.E.E., Boscombe Down, received injuries from which he died in hospital shortly afterwards. He had apparently operated his ejector seat in the last seconds before the crash.

The 525, which first flew in May of last year (and which was demonstrated at the Farnborough Show by Lt-Cdr. Lithgow) was a twin-Avon intercepter for carrier duties, designed as an interim development towards an even more advanced type—the N.113—which is the subject of a substantial order. Derived from the straight-wing Supermarine 508 and 529, the 525 had swept wings.



SOUCOUPE VOLANTE: This model of a projected "flying saucer" was displayed in Paris on July 1st by the well-known designer René Couzinet. There are top and bottom "saucers," and around the edge of each are 48 vanes which, driven by three 135 h.p. motors, rotate in opposite directions to provide lift. Forward thrust is provided by a 350 lb-thrust Turboméca turbojet.

Bristol Engine Division Appointments

NEW design appointments are announced by the engine division of the Bristol Aeroplane Co., Ltd. Dr. E. J. Warlow-Davies, B.A., D.Phil., B.Sc., is appointed deputy chief engineer of the division and a member of the divisional Board. Mr. S. S. Tresilian, B.A.(Cantab), A.F.R.Ae.S., A.M.I.Mech.E., M.S.A.E., becomes an assistant chief engineer and Mr. B. S. Massey, A.M.I.Mech.E., A.F.R.Ae.S., an assistant chief designer. Mr. B. D. Blackwell, M.A., B.Sc.(Eng.), A.F.R.Ae.S., has been made engineer-in-charge of a new department for the development of turbine blades.

Dr. Warlow-Davies

Dr. Warlow-Davies, who is an Australian, joined the Royal Aircraft Establishment in 1936, as a junior scientific officer, later worked on fatigue-failure research with the L.M.S. Railway, and in 1942 joined the Rolls-Royce experimental department, later becoming technical production engineer at the Glasgow factory and in 1946 taking charge of the Rolls-Royce North American Technical Office in Montreal. From 1947 onwards he held various appointments with Rolls-Royce in England but returned to Canada in 1951 and in November of that year became general manager and chief engineer of their Canadian organization, a position wnich he held until joining Bristol in 1953.

Mr. Tresilian, who took an engineering degree at Cambridge, spent thirteen years with Rolls-Royce and was also, for three years, chief engineer of the Armstrong-Siddeley aircraft engine division. During the war he worked as a liaison engineer with the American Army. He joined the design office of the Bristol engine division in May 1953.

Mr. Massey came to the engine division's design office in 1936 from Armstrong-Whitworth. During the early part of the war he worked in the project-office on performance calculations for new supercharger and projected engine ratings, and later became head of the supercharger section at the main design office. In 1947 he headed a section formed to design air-conditioning systems for large aircraft. Since 1951 his responsibilities have included the design of the Orpheus turbojet and development design work on the Proteus.

On the Other Side

AS we reported last week, G/C. A. F. Bandidt, A.R.Ae.S., has been appointed Handley Page representative in Australia, New Zealand and the Far East. Born in Australia, "Bush" Bandidt served in the R.A.A.F. and, for 12 years, in the R.A.F. He made—in a Gemini—the first post-war solo flight from England to Australia, and during the past three years he has visited airlines in all parts of the world in a survey on which the H.P.R. Herald has been based.

G/C. Bandidt

HIRED HELP: B.O.A.C. have chartered from Seaboard and Western Airlines two Super Constellations for service on the busy tourist route between New York and Bermuda. Built for freighting, the aircraft have only half the normal number of cabin windows, but the restricted view is presumably acceptable on this short (2 hr 40 min) run. Carrying up to 86 passengers, they are manned by Seaboard flight crews and B.O.A.C. cabin attendants.

Farnborough's Golden Day

Princess Margaret at Fifty-year Celebrations

"FLIGHT" PHOTOGRAPHS

A BRIGHT sun, an assuaging breeze, good company, noble aeroplanes, technical wonders and, above all, the gracious presence of H.R.H. Princess Margaret: these were the makings of the Golden Jubilee celebrations at the Royal Aircraft Establishment, Farnborough, on Thursday, July 7th.

The Princess arrived from Buckingham Palace in a Whirlwind helicopter of the Royal Navy, with Lt-Cdr. J. C. Jacob and Lt. W. Powell as pilots. As she descended, to be welcomed by the Lord Lieutenant of Hampshire, the Duke of Wellington, she was greeted with cheers; and having met the Minister of Supply, Mr. Reginald Maudling, and his wife, and Sir Arnold Hall (Director of the R.A.E.) and Lady Hall, Her Royal Highness went by car to begin her tour of the static show. As a memento of the occasion she was presented with a table lighter by Mr. Charles Wilshere, B.E.M., a 72-year-old joiner who has worked at the Establishment for 45 years. The lighter incorporated a model of a futuristic supersonic aircraft, and Her Royal Highness said, "It is awfully nice, and I will use it." Sir Arnold remarked: "It is our idea of an aircraft of the future," and Mr. H. T. Hill, assistant director of workshops, added, "It is an impression of a supersonic aircraft of probably some twenty to thirty years' time." (The model had a very slim fuselage, with small, straight-tapered wings having power units at their tips.)

At Cody's tree the Princess met Mr. Vivian Cody, son of the great pioneer with whose name Farnborough will always be associated, and Mr. Samuel Cody, a grandson. In reply to the Princess's question "Why did your father tie his aeroplane to this tree?" Mr. Vivian Cody replied, "The idea was that we could run the engine to test the pull. We always did this together and I often flew with my father."

The tour, and lunch, concluded, Her Royal Highness took her place to view the flying. By this time the glowing brilliance of the morning had passed; but such was the enjoyment of the occasion that there was little complaint, though it was recognized that the gathering cloud would inhibit the jet aerobatics.

Like another aerial demonstration lately in the world news, the afternoon's flying events were signalled by a salvo—though this time of starter-cartridges, in eighteen Hawker Hunters of Nos. 54 and 247 Squadrons. Quickly the Hunters streamed on to the runway for a mass take-off; whereupon one, from a height of a few hundred feet, was seen to break to starboard. It disappeared from view and a mushroom of smoke rose distantly. Nothing was said of these events, and only afterwards was it learned that the Hunter had crashed near Fleet and that its pilot had died from injuries sustained after ejection. Later the Hunter wing flew past in fine style.

The aerobatic team of No. 43 Squadron was baulked by cloud, but got in some rolls in echelon and showed how to change from echelon port to echelon starboard in a turn. The Bristol Fighter and Sopwith Pup dog-fought realistically, and the Gladiator, Hart and Swordfish completed a quintet of the best-loved biplanes ever to see British military service. A Spitfire and a Hurricane had a thoroughly good set-to, with honours fairly even; and a Lancaster, Beaufighter and Mosquito were other heroic representatives of 1940-45. To the Royal Navy, however, must go the credit for introducing something quite novel—and perfectly executed. From the left eight Gannets came whining in low, with both elements of each Double Mamba propelling them at a spanking rate. Then, as one, they suddenly shut down to half power and each feathered an airscrew. While this was happening there approached from the right a wondrous melange of naval helicopters—two Whirlwinds in the lead, four Hillers on the flanks, and six Dragonflies bringing up the rear. All subsequently landed, but one Hiller took time out for a breezy session of crazy flying and auto-rotation.

Ever-welcome visitors to any flying affair are the Coastal Command Sunderlands, and three of these, from the Flying Boat Training Squadron, Pembroke Dock, boomed over low, followed by nine Shackletons of 228 Squadron in as tight and tidy a formation as one is ever likely to see demonstrated by big aeroplanes.

Bomber Command, represented by elements of Nos. 35, 90, 115 and 207 Squadrons, put up another novel show. The first four Canberras came in as a box, and, having passed the Royal Enclosure, broke into a "Prince of Wales's feathers," the box man meanwhile diving low. The next four came in echelon and broke to port; four more broke to starboard; and the last box dispersed as the first.

The pointed-nose Javelin (after much booming and hissing on the runway) came past singing in a fine tenor voice; it Derry-turned, rolled and passed by very fast and low. The Valiant B.1 made a circumspect passage overhead; the Vulcan was lower; and the Victor lowest of all. The Britannia looked faster than ever before.

A unique formation comprised the Boulton Paul P.111 delta and the jet-deflection and prone-pilot Meteors. The delta touched down decidedly "hot" and popped its tail parachute; whereupon the jet-deflection Meteor, sitting down amazingly slowly, blasted the 'chute neatly off the runway.

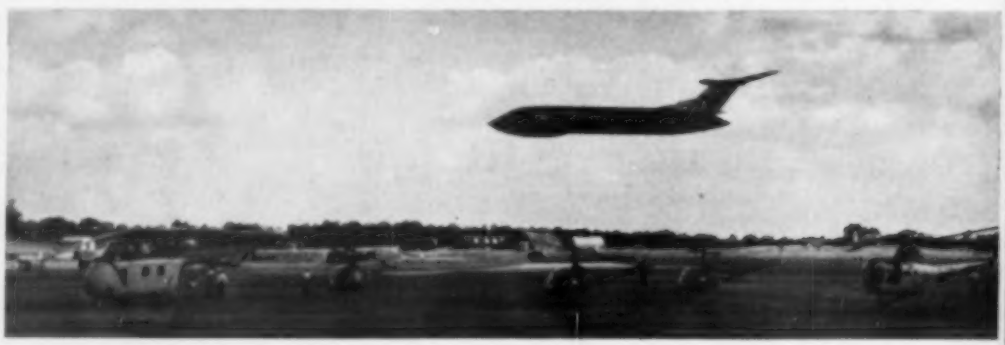
The *pièce* of the show was, of course, the English Electric P.1, making its first appearance. This fighter looks for all the world like a futuristic test model machined from the solid; but it was handled by Roland Beamont like a Canberra. Though its speed was well in the .9s, its rates of roll and turn were astounding.

A Jet Provost performed as though it had several times the thrust of its Viper, and its show was co-ordinated with the C.F.S. team of Meteors, which finished an immaculate show with a bomb-burst break-up.

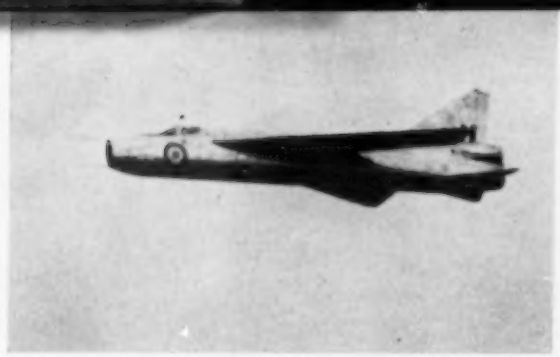
At the end came the old brigade—the Blériot and Blackburn monoplanes, Hawker Tomtit and Cygnet and Percival Gull. Neville Duke on the Tomtit did an impressively protracted falling leaf.

On the Friday the Cody kites managed to get airborne and a Hunter put up a superb individual show.

The Exhibits.—Seldom has the the R.A.E. laid itself open to public scrutiny; and never to such an extent as on Thursday,



Our report on this page that the Victor made the lowest run of all the V-bombers was in respect of Thursday's performance, but that the same held good for Friday's is confirmed by this picture, taken on that day.



On the extreme left is the line-up of the old timers, with the Blériot in the foreground. Above is the English Electric P.1 (two Armstrong Siddeley Sapphires) on one of its fast runs, and on the right the Hunter aerobatic team of No. 43 Squadron, led by the Squadron C.O., S/L. R. E. Lelong, D.F.C., tracing the path of a loop in tip-trails.

Friday and Saturday of last week. Very few people appreciate the scale and scope of work which is carried out there, since the Establishment's activities are seldom publicized; but for the Jubilee celebrations almost the whole of the Establishment was laid out like a great technical fair.

Outside "A" Shed was a wide variety of aircraft, including the Boulton Paul P.111A, the Short S.B.5, Rolls-Royce Bedstead, the jet-deflection and prone-position Meteors, Vampire with wing-flow balance, the Avro 707B, and a number of the oldest veterans (with some of the not-so-old, including the Kay gyroplane of 1934).

The deltas and the S.B.5 were loaded with canisters, probes, tufts, smoke generators and cameras for various stability, aerodynamic and manœuvre trials. The glossy finish of the "Yellow Peril" was almost lost beneath a pelt of black wool tufts.

The jet-lift Meteor, incidentally, is a complex hybrid. It is based on the original Meteor 3 airframe used as Beryl test-bed, for which purpose the wing centre-section had been modified and strengthened. The tail is that of a Mk 8 with extra fin area to balance the increased size of the nacelles. The outer wing panels are those of a P.R.10, giving more aileron control, and the nosewheel is a strengthened N.F.11 unit. The engines, of course, are Nenes.

Further evidence of the aerodynamics department's investigations was provided by a fully instrumented Hunter with a long nose boom and two other booms projecting from the tailplane leading edges. The wing-tips were tufted, and a photographed instrument panel was installed in the gun pack to record control positions and forces.

This was to assess the effectiveness of the tailplane/elevator combination at various flight speeds, and the strains which various control positions imposed on tail and wings.

Apart from full-scale test aircraft, Farnborough naturally possesses a full range of wind tunnels and these were open to inspection, the 11.5ft tunnel particularly, with a Venom wing having boundary-layer blowing over the flaps.

Yet while the wind tunnel, despite some limitations, has always been one of the major tools of aerodynamic research, the perfection of rocket propulsion and telemetering equipment has allowed free-flying models to become a major method of aerodynamic research. Such factors as longitudinal, lateral, and directional stability, resistance to roll and other aspects of performance in supersonic flight can now be investigated by constructing a small model of a few feet wing span with control surfaces and a load of sensing and telemetering equipment. This is then launched, either with its own rocket motor or on the end of a large booster which breaks away in flight. While kine-theodolites record its flight on film the telemetering equipment sends back to the ground station its own series of readings. A number of these models (with and without boosters) were shown, together with telemetry equipment for them, and films of complete launching sequences were shown.

Behind "A" Shed was shown the model rig with which the Javelin spin-recovery technique was developed at Cardington recently. A six-foot, radio-controlled, free-falling model of the Javelin was suspended on a rotating mount under the car of a parachutist-training balloon. The model, already rotating, was dropped from 3,500ft and recovered from the spin under radio control in just over 2 sec. First opposite rudder was applied, followed by pro-spin aileron and forward elevator. This produced a normal spiral dive from which the model was zoomed and the recovery parachute streamed in an almost vertical climb. A film in Shed "A" showed the full sequence of a model spin-recovery.

Naturally one of the most interesting fields of R.A.E. work, and one which has hitherto been most closely cloaked in secrecy, is that concerned with guided missiles. A considerable number of laboratories and workshops are involved in this work since it embraces aerodynamics, propulsion, guidance, fusing, telemetry, radar and many other factors. Though no actual military weapons were shown as such, an almost complete series of test vehicles ranging from the small Component Test Vehicle 1 to the 30ft-long Rocket Test Vehicle 2 were on view. One of the two R.T.V.2s shown in "A" shed had actually been fired on the Aberporth range on June 7th and recovered from the sea complete. The spherical flotation bag and triple G.Q. drag chutes were deployed; and a complete set of photographs showing drag and recovery parachute development, filmed in flight from inside the missile itself, was laid out nearby. This particular R.T.V.2 carried a gyro-stabilized radar search aerial behind a sharply pointed plastic nose cone. Several of these gyro-controlled aerials were to be seen in various parts of the Establishment, one of them locked by a pencil-beam of light on to a photo-electric cell. R.T.V.1, made by Marston Excelsior and Armstrong Whitworth Aircraft, Ltd., had a rocket motor using lox and water/alcohol giving 1,075 lb thrust for 21 sec, with a consumption of 6.2 lb/sec. The vehicle weighed 260 lb all-up and the tanks were pressurized by a solid charge. Elliott Brothers and the R.A.E. were together responsible for the radar homing head of a General Purpose Vehicle made by Short Brothers and Harland.

Missile flight is controlled by cruciform fin systems rotated either together as elevators and rudders or, differentially, as ailerons. Here either hydraulic or pneumatic power is used. A brief review of just a few of the items on show in the many laboratories dealing with guided weapons serves to give an idea of the wideness of the field and of the work being done. Included were Command Link Guidance systems for a C.T.V.1, quartz crystal stabilized centimetric oscillator, curved followers, a spectral density analyzer, optical demonstration and beam riding, conical scan and static split aerial systems, and an apparatus enabling a pilot to fly accurately within a radar beam. Micro-wave research was demonstrated by radio-Doppler effect exhibits, measurement of di-electric properties, micro-wave aerials and friction-controlled gyroscopes. Many of these devices and systems are tested by a variety of simulators. It is noteworthy, however, that none of the vehicles or equipment exhibited referred to anything more than beam-riding and semi-active (homing on radar reflections) interception techniques.

The Armament department was strongly represented, and its exhibits, together with those of other departments, will be described next week.

A well-contrived and highly entertaining show by the Royal Navy: the formations of Fairey Gannets and assorted helicopters.

HERE AND THERE

International "Nationals"

BY last week-end, the lead in America's national soaring contests (which were due to end yesterday) had been taken by a well-known British glider pilot, Cdr. H. C. Goodhart. After four days his total points were 625; Bob Smith of Pennsylvania had scored 590 and Bill Ivans of California 569.

P-16 Brake Failure

THE first Swiss-designed jet fighter, the P-16 (*Flight*, June 3rd, p. 759), was damaged last week at Altenrhein when it overshot the runway following brake failure. The aircraft overran railway tracks and "parts of the landing gear" (the P-16 has six wheels) were torn off. Flying should be resumed in about seven weeks' time.

Bang in London, S.E.—

THE mystery of a bang which awakened people in the South-East London area in the early hours of July 5th, subsequently causing widespread speculation, was finally solved on the evening of July 7th. It was then that the Hawker Siddeley Group issued a statement to the effect that W/C. "Dickie" Martin, accompanied by an R.A.F. observer, F/L. R. Jefferies, had been testing a Javelin over the Home Counties at that time. The pilot, it was stated, had unintentionally exceeded the speed of sound while endeavouring to free an entangled oxygen tube. W/C. Martin later said that for some weeks he and other pilots had been busily engaged on Javelin night flying; the development programme had been speeded up.

—Echoes in Westminster

ON Monday last, the Javelin's bang, and supersonic bangs in general, were the subject of Parliamentary questions. Mr. Maudling, Minister of Supply, spoke of measures now in hand. Most supersonic flying would be diverted out to sea, and he also proposed to instruct contractors and M.o.S. establishments that no such flying should take place below 30,000ft except in special circumstances. Broadly similar steps were being taken by the Service departments and by Commonwealth and Allied air forces serving in the U.K.

Forward-facing Seat

DR. J. H. ARGYRIS, Reader in the Theory of Aeronautical Structures, has been appointed to the Chair of Aeronautical Structures in the University of London, tenable at Imperial College. The new Chair is the first of its kind to be created in this country and the Commonwealth.

Down-to-earth T.V.

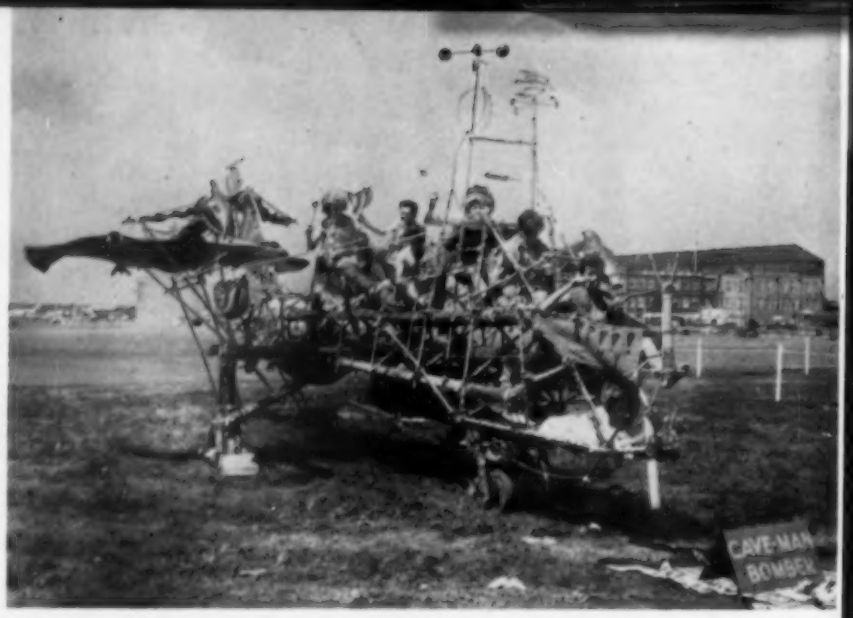
THE Air Ministry is considering B.B.C. proposals for a series of live television broadcasts, dealing with R.A.F. technical duties, to be made direct from aircraft on August 27th-29th. Successful experimental transmissions, from take-off to touch-down, were made recently from an R.A.F. Varsity.

Sociable Week-end

EIGHTY aircraft, carrying a total of some 300 R.Ae.C. members and friends, took part in the Club's Deauville Rally, held last week-end in brilliant weather—though fog delayed some participants on the outward journey. Mr. Peter Vanneck (Tiger Moth) won the sealed-time arrival contest, and Mr. T. F. W. Gunton (G.A. Cygnet) was awarded the prize for the best answer in a "first impressions on landing" competition.

Herald Registrations

REGISTRATIONS G-AODE and G-AODF have been allocated to the first and second prototype Handley Page Heralds. The first aircraft, though built in the Handley Page (Reading) factory at Woodley, is to be taken to Radlett for its initial flight trials due to begin shortly.



FOR CLUB USE, though officially designated Caveman Bomber, is this wondrous aerodyne, demonstrated at the R.A.E. Jubilee celebrations, described in earlier pages.

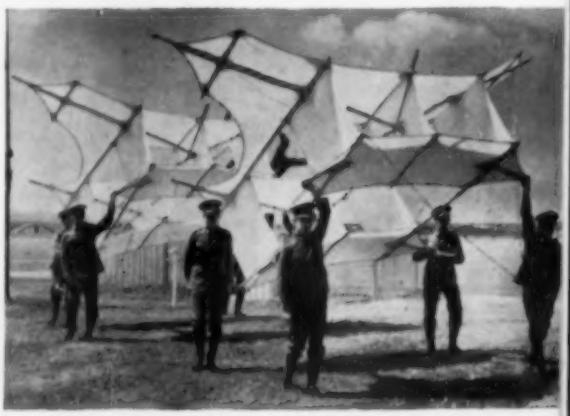
FARNBOROUGH FACTS

THE following preliminary information will assist readers who are making early plans for visits to the S.B.A.C. Show. *Dates:* Monday, September 5th, aircraft industry technicians' day; 6-8th, trade days; Friday, 9th, public premiere; Saturday and Sunday, 10th and 11th, public days. *Prices:* Friday—£1, children (under 14) 10s., cars £1 (plus fees for occupants); Saturday or Sunday—5s, children 2s 6d., cars £1 10s including six occupants (excess passengers at normal fees), motor cycle parking 2s 6d. Children are to be admitted on the three public days only. Tickets for the Friday only may be obtained in advance through Auto-Parks, Ltd., 1-31 Maclise Road, London, N.14.

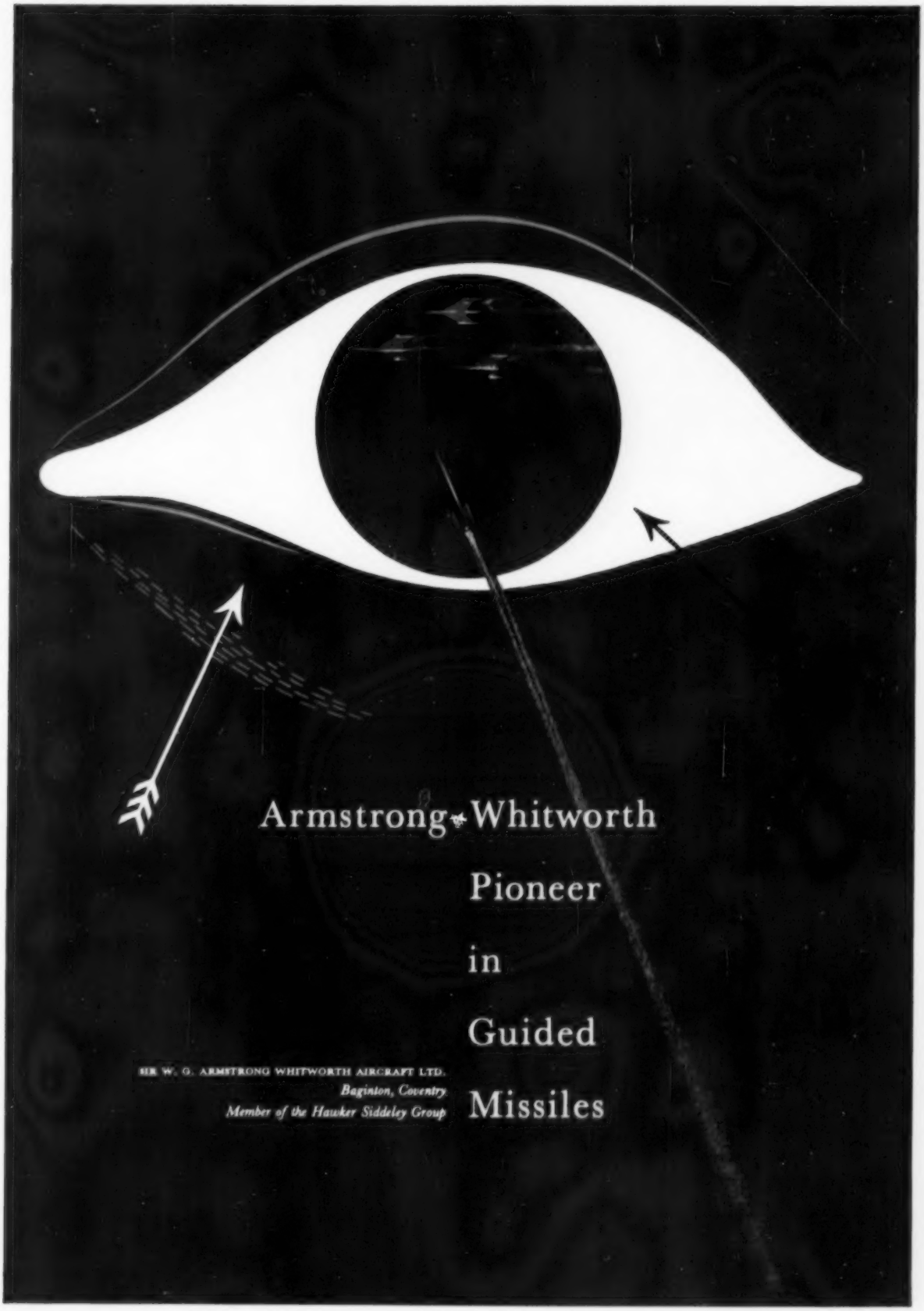
MATERIALS HANDLING NEWS

YOU CAN GAIN FROM MECHANIZATION

RECENTLY PUBLISHED, this new quarterly journal is designed to assist firms who wish to increase their efficiency by making fuller use of mechanical handling aids. Potential users of such equipment may obtain copies of "Materials Handling" on application to Dorset House, Stamford Street, London, S.E.1.



R.E.s AT THE R.A.E.—from No. 4 Training Regiment, Aldershot. Their show, complete with man-lifting kites, balloon, winch wagon, and team of horses, was organized by Brigadier P. W. L. Broke-Smith, in collaboration with Colonel Cody's son.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THE ANGLO-AMERICAN CONFERENCE

AT the fifth Anglo-American Conference, held recently in Los Angeles under the joint auspices of the Institute of the Aeronautical Sciences and the Royal Aeronautical Society, designers and engineers from both sides of the Atlantic contributed nearly a score of papers, almost all of unusual interest and importance. We have already published digests of some of these lectures, and below we give two more, together with notes—by *Flight's* technical editor, who attended the conference—on the ensuing discussions; his summaries of the discussions on certain lectures already reported are also included. Further digests of I.A.S.-R.Ae.S. lectures and discussions will appear in forthcoming issues.

INSTALLATIONS AND DESIGN: Mr. C. F. JOY'S LECTURE

THE modern mass of electrics, electronics, radio, radar, hydraulics and piping is commonly agreed to be the despair of airframe designers; but in his lecture entitled *Some Influences of Equipment Installations and Systems on Aircraft Design* Mr. Charles F. Joy, F.R.Ae.S. (chief designer, Handley Page, Ltd.), made few criticisms. Instead, he admitted that no modern aircraft can perform its proper function without such equipment, and devoted his paper to a survey of how systems can be integrated with the airframe right from the start of design.

Though considered primarily in relation to large multi-jet aircraft, most of Mr. Joy's points were applicable to all types; and, although engines are hardly "equipment," they were included, the lecturer showing that the whole design often centres around the controversial alternatives of buried installations or pods.

Mr. Joy said that the advantages claimed for pods in such matters as reduced maintenance time and lower fire-risk cannot be disputed. On the other hand, comparison of the performance of two aircraft, one with pods and the other with buried engines (having roughly the same total drag and all-up weight and each designed for the same speed, cruising height and range) showed that the aircraft with buried engines could have 50 per cent more wing area than the other. It would therefore have better take-off performance and superior manœuvrability at altitude. Also, where the use of pods made a bicycle undercarriage inevitable, buried engines again scored.

Some of the advantages of pods could be offset by careful design. If the engines were located near the fuselage, aft of the main wing spars, less damage would result from an engine fire; and large access panels could be provided without disrupting primary structure. Nor was the weight penalty of fireproof bulkheads excessive, since they could form the webs of engine support ribs and the local fuselage skinning.

Damage to the fuselage skin and stringers from high-frequency pressure fluctuations in the jet stream could be avoided by splaying out the jet pipes some 10-15 deg, with no significant loss of thrust. Similarly, it was possible to design air intakes for a buried installation that would achieve an efficiency (ram recovery) of up to 95-97 per cent on subsonic aircraft.

Supersonic cruising speeds, demanding still more power and thinner wings, might present such a difficult intake problem that buried installations would be impossible. But shock-wave formation might mean that the pod in its present form would not be the best answer; and the problem of finding a home for the engines would become more critical than ever.

Turning to aerial systems, the lecturer said that the necessity of providing a wide field of view for mechanically stabilized large radar scanners, and for suppressing efficiently all the aerial arrays fitted to a modern bomber, meant that the designer of such an aircraft was well advised to forget the lower surface of its fuselage so far as structure was concerned, and arrange from the start for a non-structural fairing from nose to tail. He illustrated an example (Fig. 1).

The problem of the very large main scanner could be solved by putting it in the fuselage nose, with the pressurized crew compartment behind, occupying the whole fuselage depth. This simplified structural problems but often resulted in inefficient crew layout. The alternative was to split the nose horizontally, with the crew in the upper half, and the scanner in the lower. The resulting pressurized floor made life more difficult for the structural designer, but a more efficient crew layout was possible, especially when a visual bomb aimer's station was necessary.

An attractive method of providing suppressed aerials for H.F. radio was to excite large structural components such as a fin or wing tip, insulating them from the main structure by plastic links. Disadvantages were the difficulty of providing sufficient strength and stiffness with the links in the structural chain, and the fact that a lightning strike might disintegrate the plastic and cause a total loss. In any case, the overall penalty in weight and drag might be less with a carefully designed external aerial system than with a suppressed system.

Because of all this electronic equipment, and other new auxiliary systems and installations, a large modern bomber needed a supply of some 200 kW of electrical power, compared with only 12 kW a few years ago. Restrictions in the use of D.C. machines on high-flying aircraft were causing a change-over to A.C. power, which also offered a saving in weight; the ultimate ideal was a constant-frequency A.C. system with paralleled outputs from a number of alternators.

By employment of constant-speed mechanical drives, such systems were already being used in the U.S.A. But the weight of the drives largely offset the saving on electrical equipment, and a better way of providing constant frequency A.C. was by a speed-controlled, air-driven turbine.

Radio and radar designers could help by standardizing the supply requirements of their equipment, which at present called for a whole variety of frequencies and voltages. The auxiliary power systems needed to cater for this situation could weigh as much as 500 lb; if this weight could be saved it would offer an increase of 50 n.m. in range or a decrease of some 900 lb in take-off weight for the same range/load performance.

Unlike all this operational equipment, powered controls were accepted, and even welcomed, by designers. In particular, the brute force provided by "all power" controls, compared with servo tabs or "power boost," offered a complete lack of limitations to the aircraft's basic layout. For example, a one-piece all-moving tail could be used for normal pitch control under all conditions, including the transonic speed range. Wide-chord ailerons could be fitted to give ample roll performance on a low-aspect-ratio wing. And the weight of the powered-control units could be offset by eliminating aerodynamic and mass balancing.

A feature which might ensure the universal adoption of "all power" was the possibility of developing what might be called an integrated control system. Fig. 2 showed (for pitch control only) a typical present-day system, in which the control movement was initiated by (a) the pilot's muscular effort, (b) the autopilot's powered output, (c) some form of blind-approach system, usually *via* the autopilot, (d) automatic short-term navigational systems, *via*

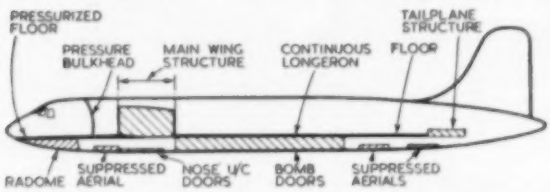

Fig. 1.—Effect of radar, etc., installations on fuselage structure.

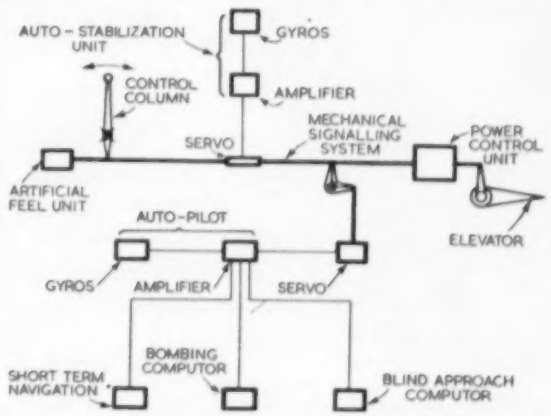

Fig. 2.—Typical existing control system (shown for pitch control only).

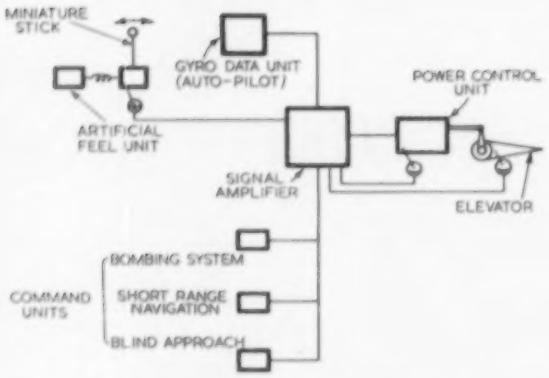

Fig. 3.—Possible future control system, shown for pitch control only.

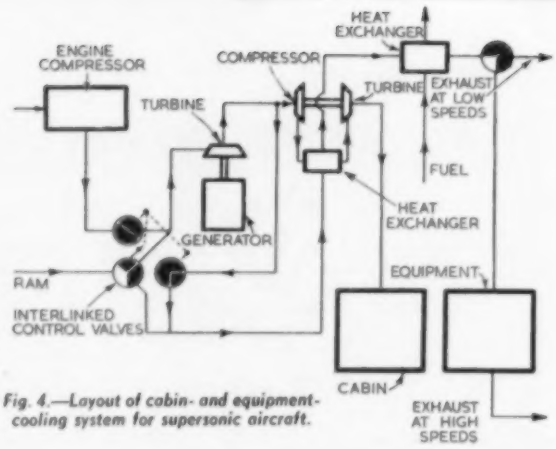

Fig. 4.—Layout of cabin- and equipment-cooling system for supersonic aircraft.

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the autopilot, and (e) bombing control system or (f) automatic flight stability systems.

Fig. 3 showed a rationalized system in which all the initiation signals were fed into a centralized signal amplifier, which mixed as necessary the different inputs, and then provided a single output signal to the powered control unit.

Air conditioning and pressurization, continued Mr. Joy, were further requirements for the high-flying jet aircraft. But, despite the vital need of providing against failure, the actual weight penalty of a pressure cabin was small in a circular-section fuselage, unless sealing compounds were used over-generously. The main problem lay in detail design at doors, windows, windscreens and other discontinuities, which affected not only strength and weight but fatigue life.

Supply of the cabin air presented less of a problem, apart from the difficulty of stowing such things as cold-air units, heat-exchangers, humidifiers, valves and ducting, because jet aircraft could draw off from their powerplants all the heated high-pressure air they needed.

The real problem for future supersonic aircraft would be to cool, not heat, their cabins; but Fig. 4 showed how this could be turned to advantage by integrating the cooling and auxiliary power generating systems. At supersonic speeds, ram air would be used initially to drive a turbine which, in turn, would drive a generator supplying all the aircraft's power requirements. The air would then bifurcate, one supply going through a compressor/turbine unit to the cabin; the other, after passing through two heat-exchangers, would be used to cool various items of equipment.

Dealing next with fuel systems, Mr. Joy explained that the first problem was to keep c.g. travel within reasonable limits now that a combination of large fuel capacity and swept wings often resulted in fuel being located at considerable distances fore and aft of the aircraft's normal c.g. He described the two basic methods of proportioning the fuel as (a) to determine the contents of each tank at intervals and adjust the booster pump speeds to compensate for uneven emptying, either manually or by complicated computing equipment; and (b) by the use of a series of "hydraulic motors," each having a fixed displacement proportional to the tank it served. Each motor was driven by fuel, pressurized by the corresponding tank booster pump; and, since the motors were on a common shaft and rotated at the same speed, all tanks emptied in the same time.

Such a system was extremely reliable and ensured that some fuel was taken from a tank in which the booster pump had failed. The basic design problem was maintenance of satisfactory internal clearances to avoid clogging while keeping efficiency.

For pressurizing wing integral or bag tanks, without a formidable weight penalty, the lecturer suggested a special wing structure with multi-spar webs and a distributed sandwich type flange with omni-directional bending strength and stiffness. With such an arrangement, the bending stresses due to tank pressures were at right angles to the stresses due to normal wing bending, so that tank pressurization could be provided for a negligible increase in structure weight.

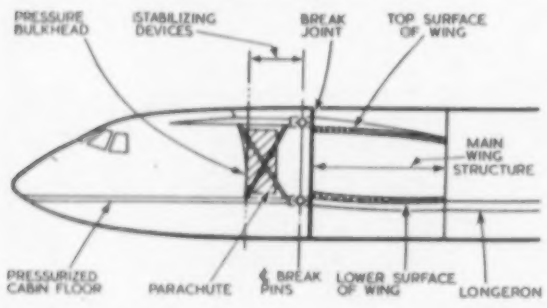
Although, like engines, facilities for crew escape in flight do not come under the general classification of equipment, Mr. Joy showed that they affect the positioning of equipment and play an important part in deciding the general design. Even the location of hatches for normal ejector-seat escape, he said, could play havoc with the local structure of a pressure-cabin and determine the whole crew layout.

An attractive solution for very-high-speed aircraft was a jettisonable cabin of the type shown in Fig. 5, although it involved the difficult problems of ensuring a clean "break" and stability afterwards.

To ensure minimum loss of structural efficiency, the break should be at a point where discontinuity was inevitable for other reasons, such as where the wing structure broke the continuity of the fuselage structure. An added advantage would be that a four-point cabin attachment could be directly to the main spar. It was equally important to locate as much equipment as possible aft of the break, to reduce the weight of the cabin and, hence, the weight and size of parachutes needed during its descent.

After discussing briefly the comparative merits of hydraulic, electrical and pneumatic systems, during which he again emphasized the possibilities of system integration, Mr. Joy completed his equipment survey with some notes on "black boxes"—the innumerable components containing electrical or electronic "magic" for which the unfortunate designer had to find room in his airframe.

These, in particular, needed to be considered from the very start of the design, because some items weighed up to 100 lb or more and required careful positioning to minimize the need for complicated, heavy support structure. Access panels had to be provided, and the need to cool or pressurize some items of equipment also complicated matters. Finally, it must be remembered



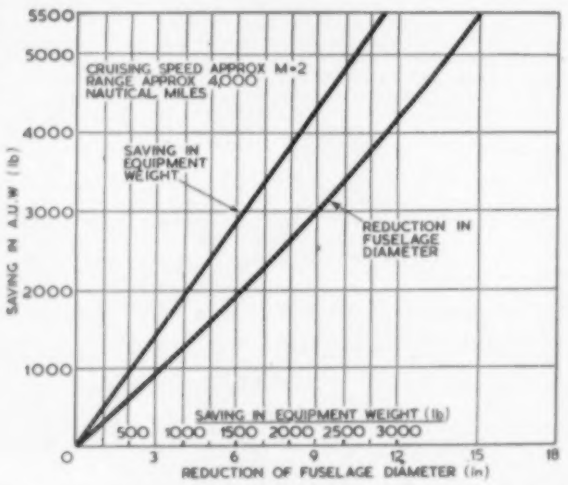


Fig. 5 (left).—Jettisonable cabin "break" structure. Fig. 6 (right).—Effect of reducing fuselage diameter, and of saving equipment weight, on the all-up weight of supersonic aircraft.

power in four packages
One big advantage of the Napier Eland propeller-turbine is easy maintenance. Eland power comes in four packages — (1) the reduction gear assembly, (2) the compressor assembly, (3) the main support plate and combustion chamber assembly and (4) the turbine unit. Interchangeability of these major components is catered for, thereby ensuring simple and cheap maintenance.
more facts about the Eland
* High aerodynamic efficiency — 3,000 e.h.p. in a maximum diameter of 36 inches.
* Low specific weight — 0.52 lbs./e.h.p.
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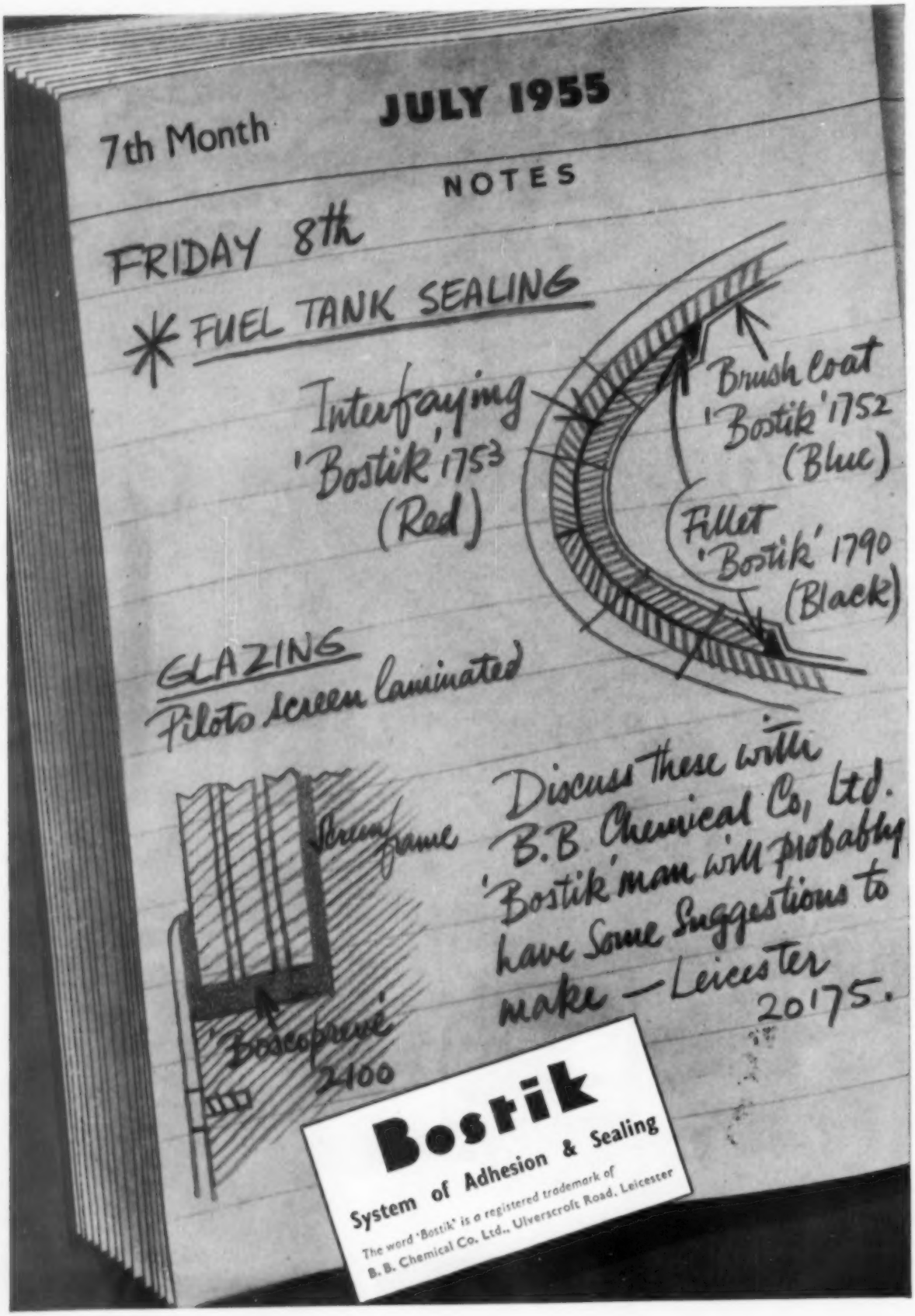
7th Month
JULY 1955
NOTES
FRIDAY 8th
* FUEL TANK SEALING
Interfaying 'Bostik' 1753 (Red)
Brush coat 'Bostik' 1752 (Blue)
Fillet 'Bostik' 1790 (Black)
GLAZING
Pilots screen laminated
Screen frame
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Discuss these with B.B Chemical Co, Ltd. 'Bostik' man will probably have some Suggestions to make — Leicester 20175.
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that individual "black boxes" were invariably connected together by heavy, bulky wiring, which must be kept to a minimum.

Mr. Joy concluded with a plea to equipment manufacturers to make every effort to reduce the weight and bulk of their products, pointing out that a 10 per cent reduction in equipment and payload made possible a corresponding reduction in structure weight. Further benefit resulted from reducing stowage volume requirements and, hence, fuselage diameter; and Fig. 6 illustrated the effect of changes in equipment weight and fuselage diameter on the all-up weight of a hypothetical future aircraft designed to cruise at Mach 2 for 4,000 n.m. It showed that savings which were helpful today may be vital in the years ahead.

The Discussion

Lt-Cdr. Bloch (French Navy) discussed electric-power generation in the simplified aircraft attempted in France. In addition to the four common solutions, the French had established a fifth—only a small proportion of the total power was required by constant-frequency electronics, and the bulk could be supplied by direct engine-driven generators, light inverters being used to provide constant-frequency supplies.

Mr. T. P. Wright (Cornell) spoke of the problems inherent in achieving high intake efficiencies, particularly as sonic speed was approached. Hunsaker had said in 1920 (Wright lecture) that "the success or failure of any aircraft depends on what it first weighs on the scales." Equipment and systems had to be determined prior to determining even the layout of the aircraft. For example, a 1,000-lb saving in an existing aircraft could offer an ultimate gain of 1,500 to 2,000 lb; but the inherent gain (applying the full growth factor) was nearer 10,000 lb. The excellent work by Ivan S. Driggs emphasized this.

Mr. Joy replied that much tunnel work had preceded the first flight of the Victor—since which time no alteration had been made to the intakes. Ram recoveries on the Victor were around 95 per cent in spite of the leading-edge sweep of some 57 deg.

Mr. R. L. Lickley (chief engineer, Fairey's) said that it was no use thinking of putting old equipment in new aircraft. Established stocks of standard units should not be drawn upon; modern aircraft had to have redesigned equipment. Powered controls, also, were a way of making better aircraft, and yet Mr. Joy seemed "to hanker after the old days of servo tabs and similar devices." The solution to constant-frequency a.c. power was to have constant-speed engines—which some manufacturers had developed.

Mr. Joy agreed that one must have specially tailored equipment, and suggested that the equipment manufacturer should not have a free hand in its design. Where an airborne auxiliary power unit was used duplication was required; it was better to use a main engine if possible.

Mr. S. Scott-Hall (B.J.S.M., Washington) emphasized that Service aircraft were designed for a specific job, and a better title for Mr. Joy's paper might be *The Influence of Aircraft Design on an Airborne Weapons System*. It had to be recognized that some of the greatest advances had been made by equipment designers.

Mr. Joy did not approve of the suggestion of going to an equipment designer and saying "here is a weapons system, you take charge." It was preferable to develop everything in parallel, although it took a long time to develop a combination of new airframe, engines and equipment.

DESIGN of LARGE HELICOPTERS

A Paper by Bell's Chief Helicopter Engineer

IN his conference paper, Mr. Bartram Kelley, chief engineer of the Texas (Helicopter) Division, Bell Aircraft Corporation, gave an account of the recent design philosophy and results of model experiments which had led up to the latest Bell helicopter project, the twin-rotor side-by-side "flying wing" helicopter.

Mr. Kelley's remarks were confined throughout the paper to transmission-driven helicopters such as were in practical use at the present time and he began by discussing the problem of disc loading. Given a certain gross weight, he said, it was advantageous from a weight and size point of view to have as small a rotor as possible, with a high disc loading. This meant a greater power requirement and, therefore, fuel load, the basic relationship for hovering flight being

$$\text{Horsepower} = K_1 \times \frac{\text{Gross Weight}^{3/2}}{\text{Rotor Diameter} \times \sqrt{\text{Air Density}}}$$

where the dimensionless constant K_1 depended on the lift coefficient, the tip speed, blade smoothness and other factors. In the early days, low disc loadings of the order of 2 lb/sq ft were used but in more recent designs values as high as 6 to 7 lb/sq ft were not uncommon. This trend was similar to the corresponding increase in aeroplane wing loadings, which had given rise to the need for longer runways for take-off.

The helicopter equivalent of a longer runway was, perhaps, a higher rotor speed and it was of interest to examine what might be the limits to increase of rotor speed. In a recent series of investigations by the Bell Aircraft Corporation, contracting for the U.S. Air Force, a Mach number of 0.92 was reached momentarily at the tip of the advancing blade, corresponding to a continuous Mach number of 0.7 in the hovering condition. The general conclusions of this paper were based arbitrarily on a fixed hovering tip speed of 700ft/sec. The effect of mean blade-lift coefficient on the disc loading had also to be considered, the basic formula being

$$C_L = \frac{K_2 \times \text{Disc Loading}}{\text{Tip speed}^2 \times \text{Solidity} \times \text{Air Density}} = \frac{K_2 \times \text{Gross Weight}}{\text{Tip speed}^2 \times \text{Blade Area} \times \rho}$$

where K_2 was another dimensionless constant having a value in the range from 6 to 7. This equation showed why an increase in tip speed allowed an increase in disc loading without changing C_L. In general, C_L was chosen as large as possible. Throughout the working range, an increase in C_L resulted in increased efficiency and a reduction in the power required to hover. However, if this gain were pursued too far, stalling of the blades on the retreating side of the disc became a limiting factor. If the helicopter were being designed for sea-level operations, a high value for C_L could be chosen; but if high-altitude flight were required, the attendant reduction in air density necessitated that this value should be lower if blade stalling at altitude was to be avoided.

One means of delaying the blade-stall phenomenon was to increase the built-in and dynamic twist of the rotor blades. Rotors with a built-in blade twist of as much as 12 deg had been flown by the Bell Aircraft Corporation with notable success, although no quantitative data on the actual stall conditions were yet available. Another method of delaying the blade stall was by means of boundary-layer control, which could be still further refined by its introduction in a cyclically varying manner to compensate for the changing airflow conditions during the rotation of the blade. The last-mentioned method was actually being tested, in spite of the obvious mechanical complications. Even these devices would eventually be limited by their weight and complexity and a basic maximum practical value of C_L would remain one of the limitations of rotors in their present form.

[*Cont. overleaf*

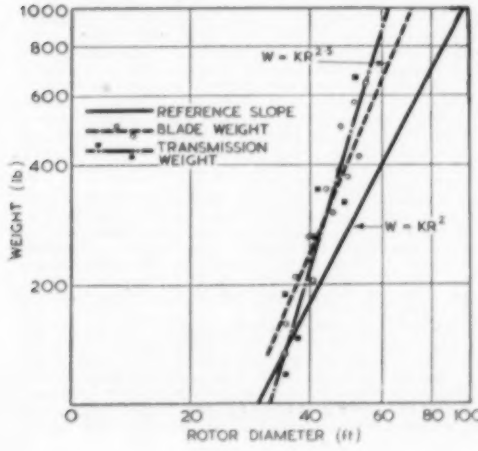

Fig. 1.—Weights of blades and transmissions plotted logarithmically as a function of rotor diameter. A square-law line is shown for purposes of comparison.

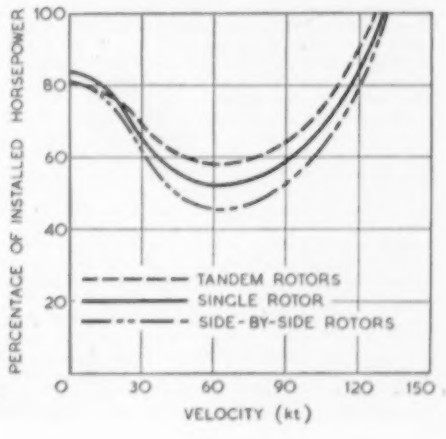

Fig. 2.—Comparison of speed/power - requirement curves for three rotor configurations.

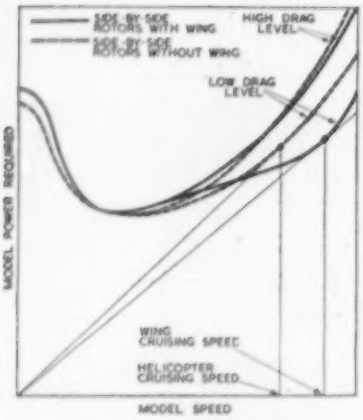

Fig. 3.—The high drag-level curves correspond to a high setting of wing incidence in relation to the angle of the rotor masts on the model, while the low drag curves correspond to a low setting.

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Ignoring any possible developments in materials or manufacturing processes, a fixed value for disc loading of approximately 4 lb/sq ft and a tip speed of 700 ft/sec had been arbitrarily assumed for the purpose of comparing different rotor sizes and configurations. A fixed value for C_L had also been assumed. A numerical value for this coefficient was rather arbitrary as it varied for different designs of blade involving twist and taper.

The lecturer went on to discuss the factors affecting the practical limitations in rotor size. As rotors grew larger, and if the tip speed, disc loading and lift coefficient were kept at a constant value, the torque required to drive the rotor increased as the cube of the diameter. This meant that the weight of transmissions and all torque-sensitive parts would have a tendency to increase in weight at a faster rate than the gross weight of the helicopter (Fig. 1). Such weight increases would reduce the payload and at some point it was obviously more economical to use two small rotors instead of one large one.

An analysis had been made of seven two-bladed semi-rigid rotors, designed by Bell, with diameters ranging from 35ft to 55ft. Using a digital computor, the following exponential equation had been obtained:

$$W_b = 880 \left\{ \frac{(\text{Disc loading} \times n)^{0.857} \times (\text{Solidity})^{0.286}}{(\text{Tip speed})^{1.66}} \right\} \times (\text{Radius})^{3.016}$$

where W_b = the weight for one of the two blades and n = the design ultimate load factor.

This equation applied only to the blades themselves and not to the whole rotor assembly. The figure of 880 was different for different rotor systems and varied with the number of blades. The remarkable thing about this equation was that, for a given family of rotor designs, it showed blade weight increasing with the cube of the rotor radius if disc loading, tip speed and solidity were kept constant. Blade taper and twist had been varied but still the cube law emerged.

It was not possible to determine a rotor diameter which should not be exceeded as so much depended on the purpose for which the helicopter was to be designed. From their own experience, however, they had concluded that the single-rotor/tail-rotor configuration was the most practical for helicopters up to a gross weight of approximately four tons. For machines exceeding six tons' all-up weight, it was advantageous to have more than one main lifting rotor.

The transition from single-rotor to multi-rotor helicopters was a unique process having no parallel in fixed-wing history and was one which profoundly affected many aspects of design. In the tandem rotor configuration certain advantages were immediately apparent: (a) Less power was required for hovering; (b) the fuselage, surprisingly enough, became smaller; (c) the machine was capable of relatively high-speed sideways flight, allowing it to come to a hover in strong cross winds; (d) during autorotational landings, a steeply flared attitude could be maintained during and after contact with the ground, thereby simplifying considerably the emergency technique.

Against these had to be weighed certain disadvantages of the tandem configuration: (1) Longitudinal static instability, manifested in the tendency of the machine to pitch upwards when a gust was encountered. (This had been overcome at Bell Aircraft by the use of an accelerometer control which automatically reduced the collective-pitch of the forward rotor when the fuselage was subjected to an upward acceleration.) (2) The tandem helicopter required more power than the single rotor machine in the cruising flight condition (Fig. 2). It followed from these considerations that the twin rotor side-by-side configuration possessed the advantages of the tandem machine without its disadvantages. In the side-by-side rotor helicopter the power required for cruising flight was even less than in the single rotor machine. This was an important consideration for twin-engined machines since it resulted in a good rate of climb on one engine (Fig. 2). The condition applied even at very low airspeeds, indicating a good emergency single-engine performance. Simplification of controls was an additional advantage since the lateral cyclic-pitch control could be dispensed with and roll stability could easily be obtained by equipping each rotor with the accelerometer control.

The most interesting aspect of the side-by-side configuration was the design of the fuselage itself. Earlier helicopters of this type had had more or less conventional aeroplane fuselages with the rotors carried on outriggers. However, for larger machines it appeared that a better solution would be to design a long, thick fuselage (to include outriggers, engines and space for passengers) which would move *sideways* through the air—i.e., a wing.

Mr. Kelley concluded his remarks by describing certain model experiments which had recently been carried out at Bell Aircraft to determine the feasibility of such a design. The technique for the tests had been developed independently by Arthur M. Young, whose original researches in the 1930s had led to the present rotor system in use on Bell helicopters. Mr. Young had devised a whirling-arm test stand, in which the operator sat in a chair which, mounted on ball bearings, turned with the arm. A model of the side-by-side twin rotor flying wing was mounted at the end of the arm and described a circle 50ft in diameter.

The wing itself was of symmetrical section, having a 40 per cent thickness ratio. Diameter of the two rotors was 51in and power was supplied by two Black and Decker electric drill motors with an interconnecting shaft. Since the whirling arm was suitably counterbalanced, the model lifted only its own weight. Similarly, the drag of the arm was counteracted by a separate drive motor so that the model only had its own drag to overcome and was, virtually, in free flight. Centrally mounted levers enabled the operator to make control movements and the wing and swashplates could be pre-set at different fixed angles in relation to the rotor masts. An additional feature was that, by using an external source of power to drive the arm, even measurements of the model's characteristics in auto-rotation could be made.

At the present stage it was too early to draw any final conclusions, but certain trends were apparent. It had been confirmed that the "wing" used less power in the cruising flight condition than did the conventional helicopter (Fig. 3). Preliminary tests indicated the possibility that no tail would be required as the rotors were a powerful agent for supplying control and stability. However, should it prove desirable to be able to introduce wing-moment changes in flight, a small control surface could extend forward of the centrally located pilot's cabin.

Discussion

Mr. D. L. Hollis-Williams (technical director, Westland Aircraft) conceded that "if Bell had found that one of their best regimes of flight was sideways there was no reason why they should not exploit it." Seriously, however, he expected stability and control problems to arise with the side-by-side-rotor design, and foresaw the necessity for a rudder. He spoke of the almost insuperable difficulty of making a reliable helicopter and suggested that, in the future, only the simplest types would survive.

Mr. Young (Douglas Aircraft): It was noted that Mr. Kelley had not mentioned operating economy. It was essential to improve the lift/drag ratios of lifting systems, since cost-per-ton-mile was inseparable from this parameter.

Mr. Kelley, replying, pointed out that the heaviest rotary-wing machine now flying was of the tandem-rotor type. He cited mail operations in Chicago, in which, blade for blade, maintenance of tail rotors was more expensive than that of main rotors. The need for good L/D ratio, he agreed, might require further reductions in disc loading.

MR. GREATREX'S PAPER DISCUSSED

THE discussion summarized below followed the Conference lecture given on June 22nd by Mr. F. B. Greatrex (chief development engineer, installation division) of Rolls-Royce, Ltd., under the title *Jet Noise*. A digest appeared in *Flight* of July 8th.

Mr. Miller (N.A.C.A.) stated that the result for take-off and landing noise agreed satisfactorily with American experience. Conway data, however, seemed to disagree with work by Tyler; it had been found that noise from shearing between the by-pass air and the central jet could exceed that due to action between the former and the atmosphere. It was American practice to integrate noise intensity over an assumed sphere from readings taken in the plane of the engine while the latter was rotated about its longitudinal axis. The Rolls-Royce results had squashed the argument that the corrugated nozzle was effective only above the choking condition.

Mr. Greatrex's equalizing of airliner all-up weights was questionable; any U.S. jet transport would be very large and would require engines of 12,000 or 13,000 lb thrust, and, as the noise of present piston-engined equipment was considered already marginal, such transport turbojets would have to be some 18 to 20 db quieter than comparable engines of today. Attention should also be paid to the noise due to turbulence in the boundary layer around fast transports, particularly towards the rear of the cabin.

Mr. Greatrex replied that, over the whole range of time measured, Comet noise agreed within 1½ db with calculated values based on ground measurements. There was growing evidence that noise from a close pair of turbojets was not twice that produced by a single turbojet. Regarding nozzles, comparisons had been made between convergent-divergent and convergent types and any "screech" expected had failed to materialize; measurements had been taken on both types

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arranged to give full expansion at a pressure ratio of 2.3 and no significant difference had been noted.

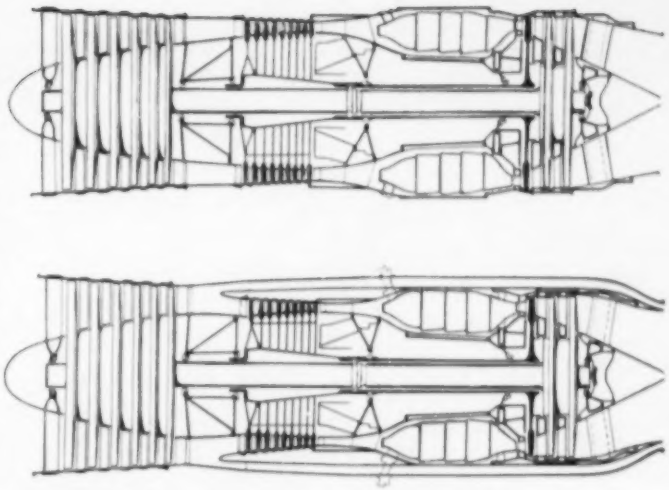
It was agreed that any large, long-range aircraft must be noisy—but a specially treated Conway could be made quieter than a piston engine. Rolls-Royce had not yet achieved reductions of 18 db but they had got perhaps 15. Aerodynamic noise was certainly very important.

Mr. E. S. Allwright (Vickers-Armstrongs): The turboprop seemed to make a good-neighbour's aircraft. Present jet noise was excessive and reduction was looked for even in engines 50 per cent more powerful.

His company had investigated the pressure-intensity close to the jet-pipe; on the Valiant—powered by "five-figure thrust" Avons—conical, finger, corrugated (6 to 60 corrugations) and convergent-divergent nozzles had been examined, taking readings chiefly about eight feet behind the nozzle and two feet (about one nozzle diameter) to one side. The results had agreed closely although the convergent-divergent nozzle showed definite advantages and gave the lowest measured intensity. A broader Valiant programme had shown reading of 150 db at 90ft and 135 db at 150ft behind and at 40 deg to the longitudinal axis.

A photograph was shown of a mobile silencer developed for the Valiant, manœuvred by a tractor which followed a white guiding line and brought the twin intakes of the silencer up to within about one foot of the bomber's nozzles (two units being needed for ground running of all four engines together). The silencer was a large mild-steel duct containing perforated steel splitters enclosing slag wool. The results had shown a reduction from 150 to 110 db and no adverse intake noise had been traced.

Mr. Greatrex, replying, pointed out that there was nothing about the turboprop which made it inherently quiet.



These two sectional elevations, illustrating the essential differences in the layout of turbojets of the plain (top) and by-pass types, were among the illustrations accompanying Mr. Lombard's paper.

DISCUSSION OF MR. LOMBARD'S PAPER

THE following discussion took place after Mr. A. A. Lombard (chief designer, aero engine division, Rolls-Royce) had read his paper entitled *Low-consumption Turbine Engines*, an abstract of which was published in our issue of June 24th.

Mr. L. Fischer (G.E.C.) spoke of the design of engines which had good supersonic performance and also performed well during the take-off and subsonic cruise regimes. In general, designers were going to higher pressure-ratios and temperatures. In supersonic flight the high velocity paid off in specific fuel consumption with increase in turbine-inlet temperature; less afterburning would therefore be used in future, the reheat section being operated nearly dry, with an almost 2:1 gain in s.f.c. In general, aircraft manufacturers wanted engine designers to err on the side of low s.f.c. rather than low weight, because something could be done about high weight.

Mr. N. R. Quinn (chief aerodynamicist, Bristol engine division) referred to a report by Illingworth (R.A.E.)—which, it was averred, few could fully comprehend—in which were discussed eleven factors governing s.f.c. and specific weight. The "fully-variable" third formula by Lombard, in which wing loading and take-off thrust were increased, was questioned. In the B.E.25 it was cruising thrust which was increased, resulting in higher and faster flight. At present, caution should be shown in increasing pressure ratio, on account of handling problems; he would not like values higher than about 12:1. Mr. Lombard had given the by-pass engine about five per cent better range than the simple jet, and also must "better" noise. Pearson's formula was cited to suggest that, in fact, what was meant was better range or better noise-level.

Mr. Lombard, replying, agreed with Mr. Fischer's observations, but pointed out that the original lecture was confined to non-afterburning engines. With increase in flight velocity, optimum temperatures went up, owing to rise in compressor delivery temperature; on the other hand, the case of 550 m.p.h. cruise in the stratosphere implied a low flame-temperature. Suggesting that the aircraft designer could tolerate weight rather than poor s.f.c. implied volume-limitation; this could be true of fighters, but the original paper had concerned itself with transports. If big metallurgical advances were likely to take place with time, then the design should be biased in favour of better s.f.c.

The formula questioned by Mr. Quinn was not intrinsically based upon take-off thrust; this parameter had merely come out in the mathematical reduction. Certainly pressure-ratios above 12:1 might today involve handling problems, but the factor to be noted was that increase of pressures and temperatures in the turboprop indicated "jam tomorrow."

Regarding the by-pass engine, if by virtue only of its lower jet velocity it achieved higher propulsive efficiency it would also be quieter; noise was a function roughly of the ninth power of jet velocity.

Mr. G. R. Edwards (managing director, Vickers-Armstrongs aircraft division) stressed the importance of Mr. Lombard's plot of turboprop efficiency with increasing pressure and temperature [reproduced in *Flight* of June 24th]; improvements in efficiency added up with the turboprop and they did not when the prop was taken off. He said this while fully aware that he was as much involved with turbojets as other speakers; and he commented on the fact that, although by-pass engines lent themselves readily to being podded, he had "toothpasted" four into a wing. Certainly jet transports would be built and they would fly faster than turboprop aircraft, but he believed that, for the great mass of the travelling public, the high-efficiency propeller-turbine was here to stay. He asked Mr. Lombard whether he believed in high pressure two-spool engines and referred to the early Rolls-Royce Clyde.

Mr. Lombard emphasized that he had described the pod as "God's gift to the by-pass engine" and not as a gift to the by-pass aircraft. There was no doubt in his opinion about high pressure-ratios, and he expressed regret at cancellation of a paper (which was to have been given by a G.E.C. engineer) on variable-stator engines. One could only match compressors when off-design by varying shaft speeds, and the only engine better than a two-spool might be a three-spool. With fixed stator blading there was but a small range of r.p.m. over which one could match the varions parameters. A large airscrew was needed to achieve high propulsive efficiency; this implied a high tip-speed but, as helical Mach number was of paramount importance to cabin noise level, cruising had to be done at low r.p.m. A wide range of operating speeds could be achieved only on a two-shaft engine. A low tip-velocity was also advantageous in that it brought the airscrew operation nearer to its point of peak efficiency.

A CRANFIELD OCCASION

LAST week we announced the appointment of the new Principal of the College of Aeronautics, Cranfield—Professor A. J. Murphy, M.Sc., F.I.M.—and it is now possible to publish a portrait. Prof. Murphy, who is Professor of Industrial Metallurgy at Birmingham University, takes up his appointment on October 1st.

The appointment was publicly announced at the College's eighth annual presentation of diplomas, held on July 1st. At this ceremony, the chairman of the Board of Governors, Sir Frederick Handley Page, welcomed the Minister of Supply (who was to present the diplomas) and said in his opening address that the work of the College had continued to expand during the past year. Mr. B. W. A. Dickson, Acting Principal, reported that 79 students had completed the two-year course, 68 of whom were to receive diplomas. During the year Prof. J. A. J. Bennett and Prof. G. A. Whitfield had begun duties as heads of the departments of Aerodynamics and Aircraft Electrical Engineering respectively. A new short course in flight-test techniques, Mr. Dickson announced, was to be held in September of this year, open to University graduates and undergraduates.

Professor A. J. Murphy.

In his speech following the award of diplomas and prizes, Mr. Reginald Maudling, M.P., Minister of Supply, said that the shortage of highly skilled men in aircraft development work was a most serious bottleneck at present. In the continued development of aeronautical science, he suggested, this country was ensuring future prosperity as well as building up her defences. A vote of thanks to the Minister was proposed by Sir Harold Roxbee Cox, who is vice-chairman of the College's Board of Governors.

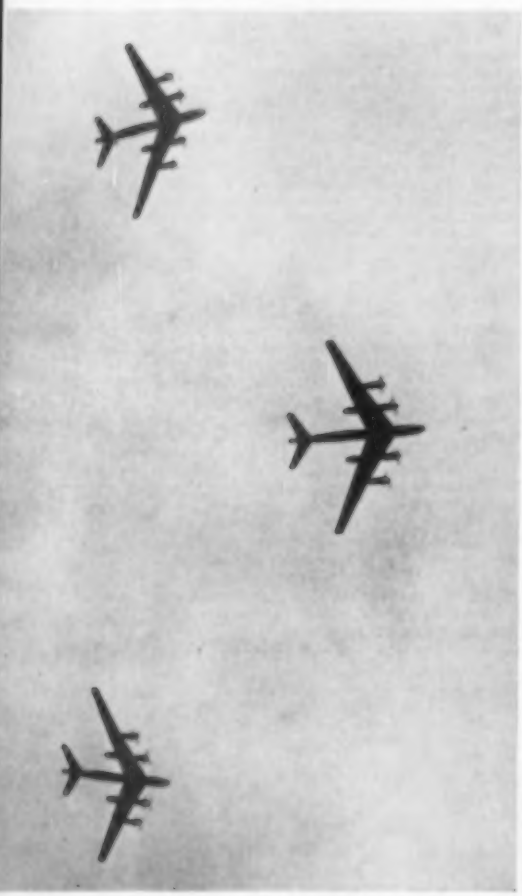
The same evening, a most enjoyable presentation ball again showed that the undoubted abilities of Cranfield students are not confined to the science of aeronautics alone.

We hope to publish, in an early issue, the names of students who received diplomas and prizes. The theses which were the subject of the majority of the awards totalled over 60, and covered wide fields within the five main subjects of aerodynamics, design, aircraft economics and production, electrical engineering, and propulsion.

The massive fuselage of the new twin-jet night-and-all-weather fighter bespeaks large fuel capacity. Wing design resembles that of the Mig-17.

GLIMPSES OF SOVIET AIR POWER

SINCE the Soviet Aviation Day (July 3rd) was reported in considerable detail in our last issue, a small selection of photographs has been procured. Some of the clearest and most informative are reproduced here. Never before illustrated are the night-and-all-weather fighters (above) and the turboprop bombers, below. The remaining two pictures are indicative of the precision with which the great fly-past was conducted.



The geometry of the turboprop bombers on the left follows that of the Boeing B-52. The lengthy inboard nacelles could contain the main undercarriage units and/or remotely controlled armament. Above are Yak training/liaison aircraft and, below, Mil helicopters of the type bearing the Allied code-name Hound. Also present were four very large twin-rotor helicopters of a class not previously seen.

The POWER of Armstrong Siddeley

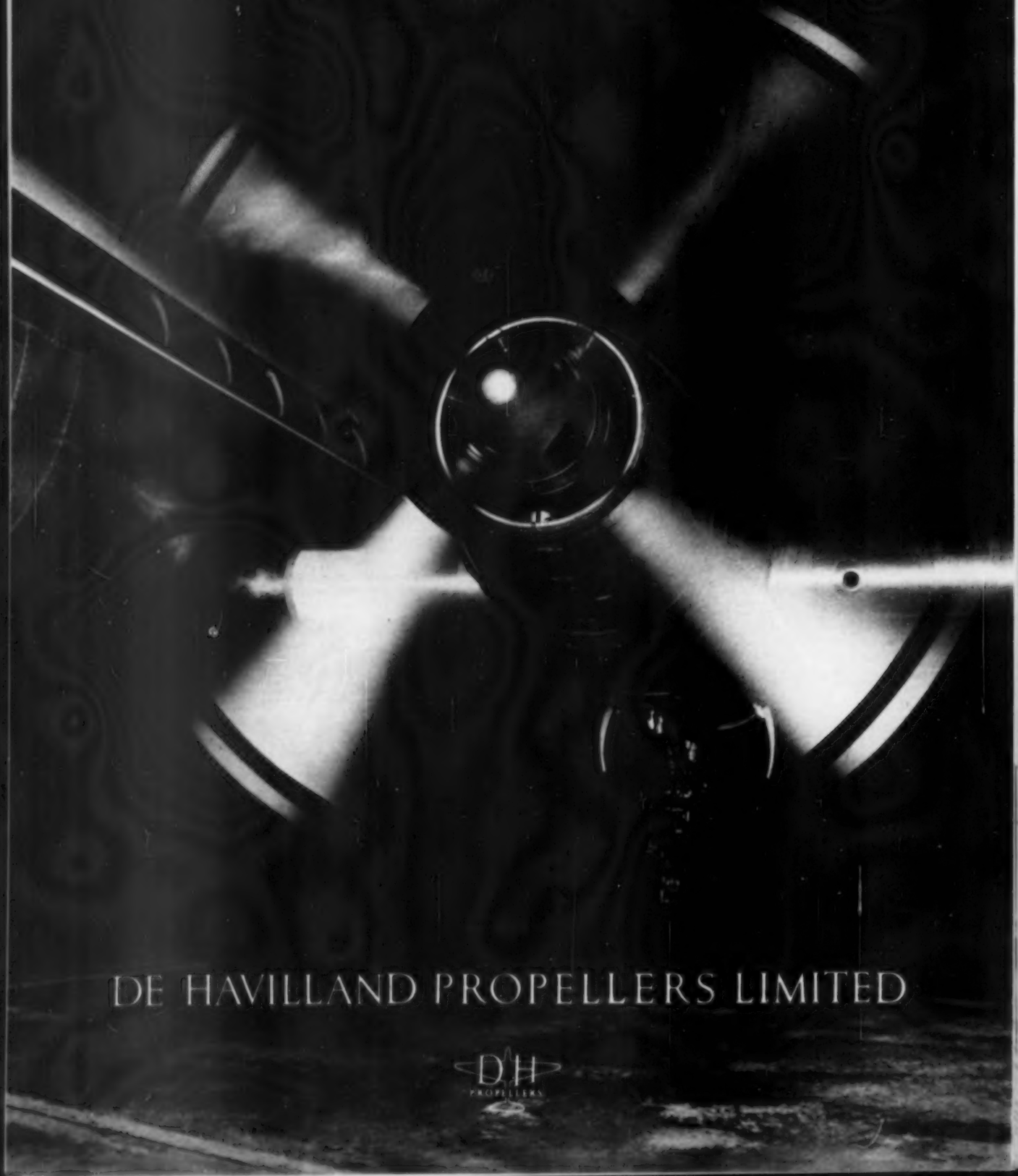
Fitted with two Armstrong Siddeley Viper turbojets and a S.E.P.R. liquid fuel rocket the French SNCASO Trident has broken through the sound barrier in a climb — the Viper is the first British engine to do so. The 'mixed power plant formula' is the next logical step in interceptor technique — the jet engines are used for substained economical cruising, the rocket supplies the extra boost required to give the aircraft the very high rate of climb necessary for the interception of high speed jet bombers at very high altitudes. This is the first time that a British engine has been used for 'mixed power plant formula'— a further achievement of the power of Armstrong Siddeley.

ARMSTRONG SIDDELEY MOTORS LIMITED

PARKSIDE · COVENTRY

Members of the Hawker Siddeley Group

de Havilland hollow-steel-blade, constant-speed feathering and reversing propellers are being fitted to the fleet of Bristol Britannia (Four Bristol Proteus propeller-turbine engines) aircraft on order for the British Overseas Airways Corporation



DE HAVILLAND PROPELLERS LIMITED

D H
PROPELLERS

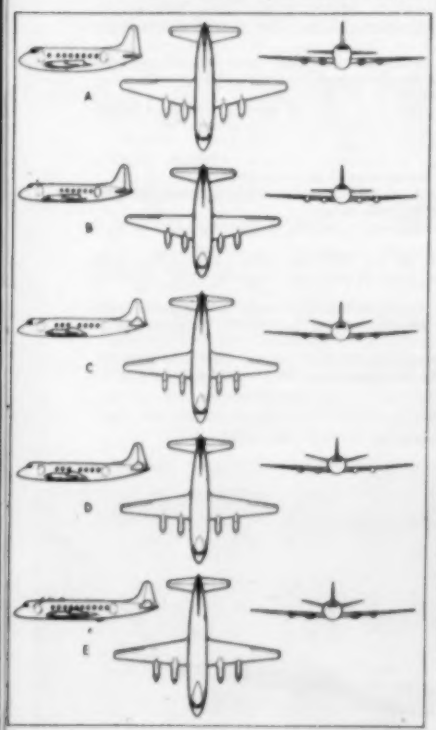
Predecessor of today's gleaming Viscount fleets, the V.630 prototype is seen on its modest debut at Wisley seven years ago.

The Story of the VISCOUNT

*Evolution of an Airliner: The First Ten Years**

THE VISCOUNT'S origins go back to 1945 when the "Second Brabazon Committee" initiated the project as part of its advice to the British Government on how best to implement the recommendations of the "First Brabazon Committee" of 1943 on desirable types of civil transport aeroplane for post-war operation.

The second Brabazon Committee submitted its final report to the then Minister of Aircraft Production, Sir Stafford Cripps, in November 1945. The Committee had, however, taken action before this to initiate the project which later became the Viscount. At its 59th meeting, on March 7th, 1945, the Committee considered Paper No. 141 (R.D.A.T. Note No. 12) which was a study of the "comparative economics of a 30,000 lb aircraft powered with jet units, Merlin engines or propeller turbines." The alternatives considered were aircraft with the following power units: (a) two 1,600 b.h.p. Rolls-Royce Merlin 90 liquid-cooled piston engines, (b) two Rolls-Royce B.41 turbojet engines, and (c) four 850 b.h.p. Armstrong-Siddeley Mamba turboprop engines.



Five stages in design: (A) double-bubble VC-2 project with four Darts (June, 1945); (B) a second VC-2 project with four Mambas (November, 1945); (C) VC-2 Viceroy project, also with Mambas (December, 1946); (D) the first Viscount: V.630 with four Darts (August, 1947); (E) V.700 (January, 1949).

The Brabazon Committee, powerfully influenced by the arguments of Mr. N. E. Rowe (now Technical Director of Blackburn and General Aircraft Ltd. and this year's President of the Royal Aeronautical Society), concluded that the best answer lay in the turboprop. As a result, it agreed that a propeller-turbine aircraft in this category should be developed and decided to recommend the Minister to take immediate action and not wait for the Committee to report formally.

Lord Brabazon accordingly wrote to Lord Swinton, then the Minister of Civil Aviation, on March 13th, 1945, and suggested that steps should be taken immediately to define the requirement for a short-haul propeller-turbine aeroplane which should be developed as soon as possible. This requirement, which later became known as the "Brabazon Type IIB," was for: *"a 24-seat aircraft, powered with four gas turbine engines driving airscrews for European and other short-to-medium range services."*

An interesting point is that this requirement was seen as a DC-3 replacement, incorporating all the latest advances in design, including the first application of propeller-turbine engines to commercial air transport.

At this time Vickers-Armstrongs, Ltd., were engaged in the design of a "stop-gap" British short-haul transport aeroplane,

**Outlining the development of the Vickers-Armstrongs Viscount from 1945 until the present time, this history was first published as an appendix to the lecture "Operating Experience with Turboprop Aircraft," delivered by Mr. Peter Masefield to the Fifth Anglo-American conference at Los Angeles on June 20th last. (Abstracts from the lecture were given in "Flight" of June 24th last.) In his acknowledgements, Mr. Masefield states that Mr. P. W. Brooks, his technical assistant, was largely responsible for compiling this concise and absorbing account of the Viscount story.*

(Below): First flown in July 1948, V.630 later appeared for a while with R.A.F.-type M.o.S. roundels.

"Flight" photograph

THE STORY OF THE VISCOUNT...

developed from the Wellington bomber. This 34,000 lb aeroplane, the VC-1 or V.491, became the Viking (with two 1,625 h.p. Bristol Hercules 634 engines) and was introduced into service by B.E.A. on September 1st, 1946.

The late Rex K. Pierson, then chief designer of Vickers-Armstrongs, Ltd., had appeared before the Second Brabazon Committee on December 20th, 1944. Discussion on that date about the VC-1 Viking had suggested that a turbojet short-haul aeroplane might be required as a Viking replacement. Mr. Pierson left the meeting to prepare a design study and to undertake a detailed examination of how best to meet the requirement. He eventually decided that the propeller-turbine offered greater promise in this application than the pure jet. The Brabazon Committee came to the same conclusion at its 56th meeting on January 3rd, 1945, when it considered (in paper No. 138) two

Modified styling is displayed by V.630 on an early B.E.A. proving flight.

short-range civil transports of 28-30,000 lb gross weight powered alternatively with two Rolls-Royce Merlin piston engines and two Rolls-Royce B.41 pure jets. The early Vickers studies of a turbine civil transport aeroplane bore the firm's drawing office designation V.453. This type number covered a range of projects examined in 1944 and also appears to have been used for the first propeller-turbine proposals of early 1945.

Thus it came about that, by the time of Lord Brabazon's letter to Lord Swinton in March 1945, discussions on the Brabazon IIB had crystallized to the point of associating the design very largely with Vickers-Armstrongs, Ltd., at Weybridge and especially with Mr. Rex Pierson. At a meeting between representatives of the Ministries of Aircraft Production and Civil Aviation and "the operators" on March 14th, the Controller of Research and Development at M.A.P., Air Marshal Sir Ralph Sorley (now managing director of de Havilland Propellers, Ltd.) stated that Vickers-Armstrongs would probably be given the contract. The airline representatives expressed their satisfaction.

In March 1945 Rex Pierson took the project a stage further when he submitted to the Ministry of Aircraft Production a design study (RKP/76072) for a VC-2 aeroplane powered with four propeller-turbine engines. It was set out in three forms as follows:—

VICKERS VC-2 PROPOSALS RKP/76072

Proposal	A	B	C
Pressurized or non-pressurized	Pressurized	Non-pressurized	Non-pressurized
Passenger capacity ...	24	24	37
Gross weight	34,200 lb	35,250 lb	38,600 lb
Wing area	855 sq ft	880 sq ft	965 sq ft
Wing span	87.5ft	89.0ft	93.0ft
Length	60.0ft	62.0ft	65.25ft
Cruising speed ...	296 m.p.h.	292 m.p.h.	284 m.p.h.
Cruising height ...	20,000ft	10,000ft	10,000ft
Still air range	1,000 st. mls	1,000 st. mls	1,000 st. mls

Prototype V.630 in the original colour-scheme. At 40,000 lb (later 43,000 lb) the aircraft was 20,000 lb lighter than today's Viscounts.

These proposals were considered by the British Ministries of Aircraft Production and Civil Aviation and on April 16th, 1945, Sir William Hildred (then Mr. W. P. Hildred, Director General at the newly formed Ministry of Civil Aviation and now Director General of I.A.T.A.) wrote to the Permanent Secretary of the Ministry of Aircraft Production (Sir Archibald Rowlands) to say that his Minister, Lord Swinton, endorsed the recommendations of the Brabazon Committee that the Type IIB should be developed.

On April 19th Sir Ralph Sorley instructed the Director of Technical Development, Mr. N. E. Rowe, to proceed with arrangements for the development of the Type IIB by Vickers-Armstrongs. At this time the M.A.P. considered that four prototypes should be ordered and that these should be closely spaced in time.

During April and May, 1945, there was much discussion between Vickers-Armstrongs and M.A.P. about the relative claims of pressurization and non-pressurization. A study (RKP/76323) handed by Rex Pierson to N. E. Rowe, during a visit by the latter to Weybridge on May 26th, finally swung the scales decisively in favour of pressurization and a cruising altitude of between 20 and 30,000ft. The aircraft was now visualized with a gross weight of 34,500 lb powered by four 1,000 b.h.p. propeller-turbines and with a cabin pressurized to a differential of 6½ lb/sq in to give an 8,000ft cabin altitude while cruising at 30,000ft.

An outline of users' requirements for the Brabazon IIB—which was described as a "24-seater general purpose transport aircraft"—was transmitted by the new Ministry of Civil Aviation to Vickers-Armstrongs on May 11th, 1945. The requirements were specified as follows:—

(a) The design was to be for an "all metal" civil aircraft powered by four propeller-turbines for short and medium range operation.

(b) It was to be pressurized to 6½ lb/sq in.

(c) It was to be a 24-seater with most of the seats forward facing and was to have one toilet and a galley of not less than 4ft × 3ft.

(d) It should have a freight capacity of 300 cu ft.

(e) It would have a crew of three and one steward but the possible conversion to a two-crew layout was to be considered.

(f) A low overall noise level was specified with a maximum propeller tip speed not exceeding 650 ft/sec.

(g) The cabin floor loading was to be 100 lb/sq ft and 150 lb/sq ft for all-freight flooring.

(h) The payload was to be not less than 7,500 lb with four crew and a still air range of 900 nautical miles at a cruising speed of 240 kt (277 m.p.h.) at 10,000ft.

(i) Tankage was to be for 1,200 nautical miles with provision for fuel jettisoning and the aircraft was to be capable of operating at 30,000ft.

(j) The rate of climb specified was 300ft/min with one engine out, flaps and wheels down; the landing run 1,200 yds; and a stalling speed of 70 kt.

Airline history in the making: V.630's departure from Northolt on the first scheduled turboprop service (July 29th, 1950).

(k) There was to be no ballast for any normal operating condition and a radio weight allowance of 500 lb must be made.

(l) Undercarriage retraction was to be: 7 sec at 32 deg F and 12 sec at −12 deg F. Flap retraction was to be 3 sec from fully extended to approach position, and 15 sec from approach position to up position.

(m) The brakes were to be hydraulic.

(n) Thermal de-icing was preferred.

On June 13th, 1945, Vickers submitted their first firm proposals for the VC-2 (in a brochure RKP/76522). The aircraft was designed to carry 7,500 lb of payload over 1,040 st. mls at 297 m.p.h. at 20,000ft. Accommodation was to be for 24 passengers in a cabin 9ft 4in wide. The fuselage section was to be a double-bubble with the floor line as the common chord to the two circular sections (see p. 83). The design was then based for the first time on four Rolls-Royce Dart turboprops developing 1,130 e.h.p. for take-off with a gross weight of 34,500 lb. The wing was to have an area of 860 sq ft and a span of 88ft. The length was 63.75ft. The prime cost of this aircraft was estimated at £58,000.

This double-bubble short fuselage 24-passenger VC-2 was in fact the origin of the Viscount. The nose form and large windows remain today. Provision was made in the design for the installation, as alternatives, of either the Armstrong-Siddeley Mamba or Napier Naiad turboprops which were also under development at this time. The Mamba was of similar power to the Rolls-Royce engine but the Naiad was rather more powerful, thus slightly stepping-up the VC-2's weight and performance. Although the Ministry continued to keep an open mind on the power unit which should go into the VC-2, Vickers were clear in their own minds by October 1945, that, provided the engine made satisfactory progress, they would be fitting Darts.

On July 3rd, 1945, the Director General of Civil Aviation sent to M.A.P. a further statement of users' requirements for the Type IIB. These had been drawn up "after consultations with the operators." They specified a 24-passenger aeroplane with a crew of four. 7,500 lb of payload was to be carried for 1,000 st. mls at 275 m.p.h. at 10,000ft. The ability to operate from 1,200 yd runways and a stalling speed of 80 m.p.h. were also specified.

In September 1945 Rex Pierson was made chief engineer of the Aircraft Division of Vickers-Armstrongs, Ltd. He was succeeded as chief designer by G. R. Edwards (now managing director of the Aircraft Division of Vickers and a vice-president of the Royal Aeronautical Society) who had previously been the firm's experimental works manager. From this time George Edwards played an increasingly important part in the VC-2 project. Pierson's influence was paramount in pushing the VC-2 through from first proposals to prototype contract but Edwards took charge of actual design work from the autumn of 1945 onwards. After Pierson's death early in 1948, Edwards assumed complete technical responsibility for the project and has brought it to its success of today.

In November 1945 Vickers prepared a further design study (RKP/78322) in which the firm made a detailed assessment of the VC-2 with double-bubble and circular section fuselages. The assessment favoured a circular fuselage with no belly holds. As a result of this, when a contract was placed with Vickers on March 9th, 1946, it was for an aircraft with a circular section fuselage of 10ft 8in external diameter for four-abreast passenger seating. This basic fuselage section remains with the Viscount today and is indeed one of the few parameters in a transport aeroplane which is not easily altered during development and progressive "stretching" of a design.

In October 1945, at the 61st meeting of the Brabazon Committee, anxiety was expressed about the rate of progress with the Vickers VC-2 project. As a result, the Ministry of Supply asked four other firms—Handley Page, Short Bros. and Harland, Armstrong Whitworth and Blackburns—to prepare design studies for a similar aircraft. The Ministry still proposed that Vickers should design and manufacture two prototypes, one as a private venture and one under Ministry contract. Although, by this time, Vickers were busily engaged in investigating this aircraft, they still did not accept the Ministry proposals.

In full B.E.A. colours, the V.630 looked more like the Viscount of today.

"Flight" photograph

The V.633 Tay-Viscount, which was to have been the second V.630, was completed for military research, to M.o.S. specification E.4/49.

The tenders to the Brabazon IIB (16/46) specification submitted by the four additional firms were considered early in 1946. As a result, two prototypes of the design submitted by Sir W. G. Armstrong-Whitworth Aircraft, Ltd., were eventually ordered as an "insurance" against failure of the Vickers project. These two aeroplanes, known as the A.W.55 Avon (later Apollo) with Armstrong Siddeley Mamba propeller-turbines, were completed and extensively flown but were not put into production. The "insurance" was not required.

The VC-2 (now named Viceroy) was first ordered in the form described in a Vickers brochure (RKP/78417) of March 1946. The aircraft was basically similar to the design outlined in the first Vickers proposals except that it now had a circular-section fuselage lengthened by 21 inches to give it an overall length of 65.5ft. Accommodation was thus offered for up to 28 passengers. Alternative engine installations were for four Darts, four Mambas or two Napier E.128Ds—coupled Double-Naiad power units.

On April 17th, 1946, the Ministry of Supply specification 8/46 for a Brabazon IIB civil transport aircraft was issued to Vickers-Armstrongs. It specified:—

(a) A short-to-medium range transport aircraft powered by four turbine engines.

(b) A 24-seater with a possible 32-seat conversion.

(c) Freight capacity was to be 275 cu ft.

(d) Noise level specified was not more than 60 decibels in cabin and 70 decibels in cockpit.

(e) The working differential pressure was to be 6½ lb/sq in with 1 lb of fresh air per minute per person at all heights. There was to be an individual cold air supply to passengers and a humidity controllable between 40 and 60 per cent.

(f) Emergency oxygen for crew was required.

(g) The aircraft to be capable of carrying 7,500 lb payload for 700 nautical miles at 240 kt at 20,000ft. Total fuel capacity to be 1,200 nautical miles range and the aircraft must be capable of cruising at 30,000ft.

(h) Specified stalling speed was 70 kt E.A.S. with flaps and chassis down, take-off 1,200 yd with all engines, but the aircraft must be able to take off with one engine cut. Landing run, 1,200 yd.

(i) Seats must be readily removable for freight conversion.

(j) Specified floor loadings: passengers 100 lb/sq ft. Freight 150 lb/sq ft.

Design work went ahead on the basis of these proposals and construction of two V.609 prototypes (to specification No. 8/46 of August 13th, 1946) was finally ordered and started in December of that year. The V.609s, as laid down, were intended each to have four A.S. Mambas because the Armstrong-Siddeley engine at that point appeared to be making better progress than the Dart.

The Mamba V.609 was to have had a gross weight of 38,170 lb (which grew to 39,500 lb) and it had a rather larger wing (the area was 885 as against 860 sq ft and span 89 as against 88ft) than had been specified in the March proposals. The fuselage had also received another "tug" and was now some nine feet longer and accommodated up to 32 passengers in an overall length of 74.5ft. This extension had been decided on as a result of a B.E.A. requirement for 32 passengers. The new airline had been in course of formation during the spring and summer of 1946 and was formally constituted on August 1st. B.E.A. was giving close attention to the Viceroy project at this time. When the prototypes were laid down at the end of the year, the Corporation's interest was keen. B.E.A.'s chief project and development engineer, Mr. R. C. Morgan, had actually been closely associated with each stage of the project since June 1945 and he continued —and continues—to be responsible, from the operator's side, for all Viscount development. B.E.A.'s project and development branch has expended some 350,000 man-hours on the Viscount project since its inception.

The Ministry of Supply (as M.A.P. had now become) made a further study of alternative power units for the VC-2 in March 1947 (R.D.A.C. note No. 48) and came out strongly in favour of the Mamba installation. However, the Vickers specification (No. 81068) of August 1947 still showed the Dart, Mamba and Naiad

THE STORY OF THE VISCOUNT . . .

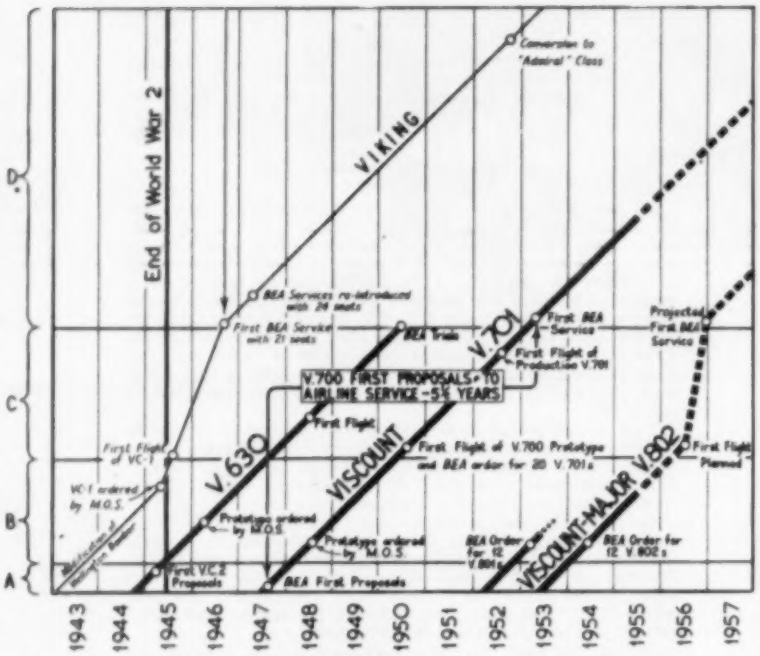
in parallel and it was clear that the firm retained an open mind on the subject.

This specification is interesting because, besides dealing with the existing VC-2—now called V.630 Viscount—with the three alternative engines and gross weights ranging from 38,170 lb with the Mamba to 39,050 lb with the Naiad, it also described a longer-range V.640 Viscount Mark II, powered by Naiads, with a gross weight of 43,500 lb.

In September 1947, B.E.A. prepared a study of alternative power units in the VC-2 (P. and D. paper PP/579). In a comparison of versions of the aircraft with four Merlin 22, four R-2000-3 Twin Wasps, two Centaurus 57 and four Mambas, the study concluded that the Merlin installation was the most attractive in this size of airframe. The conclusion drawn was that the turboprop design should be "stretched" still further.

In spite of this, on August 27, 1947, the Ministry wrote to Vickers instructing them to proceed with the Dart which had been fundamentally redesigned and much improved. First one and then both V.609 prototypes were accordingly converted into V.630s with the Rolls-Royce engine. Work proceeded on construction of these aircraft in the experimental shop at Wisley.

Rex Pierson died on January 11th, 1948. By then construction of the first prototype of the design he had inspired was well advanced and it finally flew for the first time from the grass strip at Wisley aerodrome six months later on July 16th (a photograph appears at the head of p.83). The pilot was the late Capt. J. "Mutt" Summers, the veteran Vickers chief test pilot. G-AHRF, the V.630 was the forty-third prototype he took up on its first flight.



Four phases of Viking and Viscount development: (A) preliminary discussion; (B) design and prototype building; (C) prototype and pre-production flying, and (D) airline service. In the case of the Viking the curve here shown is extended to eight years in B.E.A. service; thereafter this aircraft becomes a secondary type.

As a sidelight on the development of the aeroplane, several of those concerned with the earliest proposals for the VC-2 are now dead—including Rex Pierson, "Mutt" Summers, and Sir Hew Kilner. Meanwhile, B.E.A.'s doubts about the economic characteristics of the small-bodied V.630 were increasing. The study of the previous September had shown that the turbine was less attractive than equivalent piston engines in a design with the characteristics of the V.630. Accordingly, late in 1947 B.E.A. made proposals for an enlarged Viscount with a bigger wing and higher weights. These were elaborated in April 1948 when three alternatives were considered: a 32-passenger aeroplane with the V.630 body but an enlarged wing powered with two Bristol Hercules 700 series piston engines; a 40-passenger aeroplane with a correspondingly stretched body, the enlarged wing and four Dart engines of increased power; and a 40-passenger aeroplane with bigger body and wing powered by two Bristol Centaurus piston engines.

The Hercules-powered small body/large wing aircraft and the Dart-powered large body/wing aircraft seem to have been studied by Vickers as the V.652 and V.653.

On August 6th, 1948 B.E.A. proposed to the 19th meeting of the Interdepartmental Civil Aircraft Requirements Committee —the Government body at that time responsible for co-ordinating civil aircraft procurement—that it should order an enlarged Viscount powered initially with two Centaurus piston engines and that plans should be made to re-engine these aircraft with Dart propeller-turbines at a later stage. An alternative B.E.A. proposal was that the Corporation should order an entirely new enlarged Dart-engined Viscount. (These proposals were set out in I.C.A.R. Paper No. 35 of November 28th, 1947.)

First off the Viscount production line was V.701 G-ALWE, here seen on its maiden flight at Wisley.

Neither of these suggestions was accepted by the Government, and B.E.A. agreed instead to confirm the order for 20 Airspeed Ambassadors which had been placed at the end of 1947. As these aircraft—later to become known as Elizabethans—were powered with two Centaurus piston engines and were closely similar in size to the enlarged Centaurus-powered Viscount proposed by B.E.A., this was clearly a logical decision. The first Elizabethan prototype had flown in July of the previous year and the design showed great promise. It therefore seemed likely to be well ahead of an equivalent Vickers piston-engined design.

The confirmation of the Elizabethan order by B.E.A. marked the lowest point in the fortunes of the Viscount. At this time it seemed that the project was doomed. The early flights of the V.630 prototype that summer started, however, to turn the tide. Turboprops had such obvious attractions that there was soon a new swing of opinion in their favour. This trend was strengthened by proposals from Rolls-Royce for a new, up-rated, Dart engine of 1,400 s.h.p. (1,550 e.h.p.). The scheme, already suggested by B.E.A. to stretch the V.630 so as to improve its economics, immediately became possible with these new engines. Before Vickers finally agreed to do this, however, they produced one further set of proposals on the basis of the smaller V.630-type airframe. In November, 1948 (specification 88840) Vickers proposed a developed V.630 powered by the new 1,400 s.h.p. Dart R.Da.3 engines. This aeroplane had the same small wing and body as the V.630 but the gross weight was raised to 45,000 lb. Passenger accommodation for up to 43 passengers was to be provided, in spite of the small body, by accepting some loss in standards. The cruising speed was 333 m.p.h.

These proposals did not appeal to B.E.A. or the Ministry of Supply, but as a result of further representations from B.E.A. a new Vickers specification (89356) in January 1949 set out for the first time proposals for the aeroplane which subsequently became the V.700 series Viscount. On February 24th the Ministry placed a contract with Vickers for one prototype V.700. This was largely an expression of official faith in the prospects of the design on the part of the then Controller of Supplies (Air) and U.S. (Air) at the Ministry of Supply (Sir Alec Coryton and Mr. Cyril Musgrave). The second V.609 prototype airframe (G-AHRG) had not been completed in its original form but was diverted for use as a flying engine test bed for the Rolls-Royce Tay pure jet at the time of the confirmation of the B.E.A. Elizabethan order. This aircraft (VX217), known as the V.663, finally flew with two Tays on March 15th, 1950.

A third prototype of the original small Viscount had at one time been contemplated by Vickers as a private venture addition to the two aircraft for the Ministry. Components manufactured for this airframe were used for the V.700 and this prototype was thus manufactured in the short time of eighteen months. It

(*Concluded on page 93*)

AS IT WAS . . .

THE S.E.5 was designed at the Royal Aircraft Factory (now Royal Aircraft Establishment), Farnborough, in 1916 by Mr. H. P. Folland. As the S.E.5A, shown above, it became one of the most successful fighters in World War I and will always be associated with such legendary Air Force names as Ball, McCudden and Mannock. Fighters designed by Folland served in the R.A.F. in both World Wars and in the years between. Today, Folland's name is perpetuated in association with the remarkable little Gnat lightweight fighter, the most advanced of its type in the World.

Still the pace quickens, and every new project brings fresh problems. Questions about fuels and lubricants to meet these increasingly exacting conditions are the constant concern of ESSO research groups whose information and advice are freely at the disposal of enquirers with problems in this field.

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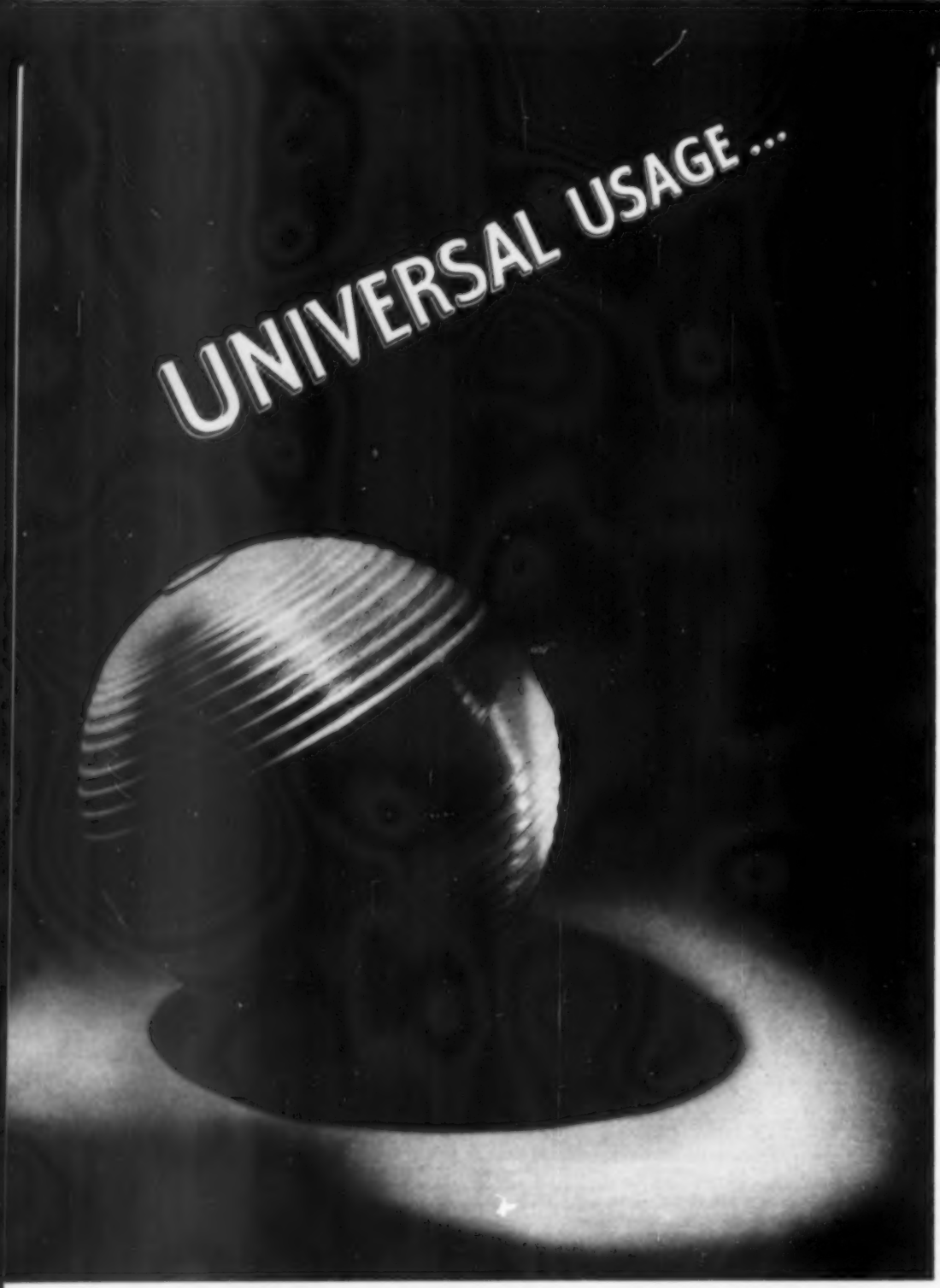

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Viscount N7402, posing for the camera shortly before the ferry flight to Washington, makes a fine picture in its Capital colours.

THE DOLLAR-EARNING VISCOUNT

Development of a British Turboprop Airliner for Service in North America

AS these words are written Capital Airlines are completing plans for the opening of passenger services between Washington and Chicago with the Vickers-Armstrongs Viscount turboprop airliner. When these plans become reality the Viscount will be the first turbine-powered aeroplane to carry fare-paying passengers on a United States domestic route, and the first British airliner of any type to be approved for revenue airline service in the United States.

Flight's salute on this Capital-Vickers occasion takes the form of the new cutaway drawing reproduced overleaf, which was designed to emphasize features particular to the North American Viscount. The aircraft illustrated is, in most respects, representative of (so far) 92 Viscounts, of which 60 have been ordered by Capital Airlines, 26 by Trans-Canada Air Lines, five by private corporations in the United States, and the remaining one by the Canadian Department of Transport. These 92 aircraft are sufficiently similar between themselves—and dissimilar enough to all Viscounts ordered for service elsewhere—to be considered as a separate branch of the Viscount family: hence our use of the term North American Viscount.

The evolution of this version vividly expresses the theme of manufacturer-operator liaison, which has dominated the development of the Viscount as a world-wide airliner. Superficially, there appear to be few differences between any aircraft in the V.700 series; in fact, each Viscount customer has influenced the design and construction of his particular aircraft, although to a varying extent. It might thus be said that there is no such aircraft as a standard Viscount.

The 229 aircraft ordered to date may, however, be regarded as offsprings of three parent versions, with the V.630 and V.700 prototypes as grandparents. These parent versions (with the number of "descendants" shown in parentheses) are the V.701 for B.E.A. (104); the long-bodied V.802 for B.E.A. (33); and the V.724 for T.C.A. (92).

As a measure of the depth of development work involved in meeting "customer requirements," it may be noted that the total design man-hours spent on the original V.700 were matched by those devoted to the V.701—and, moreover, that design of the V.724 to T.C.A.'s specification was a drawing-office project of comparable magnitude.

The work of producing a North American Viscount began in earnest when Mr. George Edwards returned from a flying sales visit to Montreal in 1952 with T.C.A.'s initial contract for 15 aircraft. The order was subject to a re-working of the design to the engineering and operational requirements of the Canadian airline, and the resulting discussions between Vickers and T.C.A. led to a list of some 250 changes in the 700-series Viscount as then in production.

Many of these modifications were required to "winterize" the Viscount, which had previously been ordered only for temperate or tropical areas. With the prospect of cold-weather operations in mind, the V.700 prototype had been sent to Northern Canada early in 1953 for two months of trials, which gave useful—and encouraging—results. This journey, incidentally, made the Viscount the first—and, as yet, the only—turboprop aircraft to complete a two-way Atlantic crossing. Other modifications resulted from T.C.A.'s desire to use North American equipment wherever fleet standardization could be maintained, and ease of servicing improved, without loss of efficiency.

A third factor influencing the ultimate form of the North American Viscount was that T.C.A.'s engineers, with their impressive background of operational experience, regarded some features of the existing version as capable of improvement—and did not hesitate to say so. T.C.A.'s criticisms, offered constructively and received in the same spirit by Vickers, undoubtedly helped to "improve the breed"; and some of the Canadian-inspired modifications will be standard on future Viscounts.

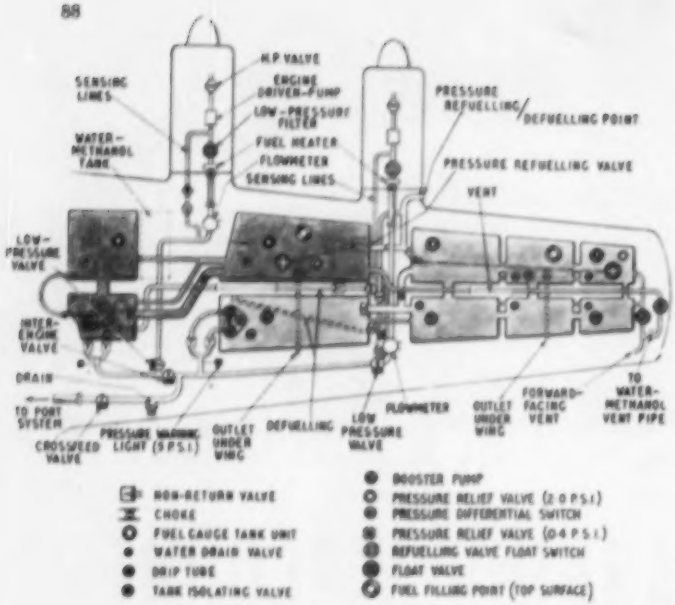
When, early in June 1954, Capital Airlines signed a contract for three Viscounts (with an option, soon taken up, on 37 more), the first of T.C.A.'s V.724s was approaching completion; it was delivered, incidentally, in December of that year—25 months after the signing of the T.C.A. order. The existence of a North American version was of immeasurable value to Vickers in the negotiations leading up to the Capital contract—as shown by the United States airline's original proposal to buy the V.724 in virtually unaltered form.

In the event, a number of new "customer requirements" emerged during the discussions between Capital and Vickers engineers which followed the signing of the American order. But—as the following pages will show—the differences between the Canadian and U.S. versions of the Viscount are not of a radical kind; they have not involved large scale re-designing, with consequent prejudice to delivery times.

A few words might be said at this point about U.S. certification of the Viscount, a subject which at one time received more than its share of pessimistic and ill-informed comment. It will be appreciated that an airliner carrying fare-paying passengers must be approved as fit to perform this work by the airworthiness authority of the country of registration. Canadian airworthiness requirements are based on those of Great Britain so, in most respects, the Viscount automatically qualified for a Canadian C. of A., and this endorsement is sufficient to permit the operation of T.C.A. Viscounts from United States airports. A Capital Airlines Viscount operating from the same airports, however, requires the approval of America's airworthiness authority, the Civil Aeronautics Administration.

The question of an American type certificate for the Viscount was approached jointly by the C.A.A. (which sent a team to England to study the design, construction and operation of the aircraft) and its British counterpart, the Air Registration Board. The outcome of these negotiations was a letter, dated July 20th, 1954, from Mr. F. B. Lee, administrator of the C.A.A., to Mr. R. E. Hardingham, chief executive of the A.R.B., listing 26 items which would require modification in order to make the Viscount

THE DOLLAR



(Left) Layout of the "four-tank" fuel system developed for T.C.A., and incorporated in the Viscounts of Capital and, later, other airlines. Fuel cells, housing a total of 1,916 Imp gal, are of flexible Hycar rubber. Normally each engine draws fuel from its own tank, but provision is made for cross-feed. Inboard tanks (shaded) comprise six of the 20 cells.

TWO-MAN FLIGHT-CREW WITH OCCASIONAL THIRD SEAT
PASSENGERS' CARRY-ON LUGGAGE BA
MAIN PASSENGER ENTRANCE, VESTIBULE FLOOR LOWERED TO INCREASE HEADROOM
UNDERFLOOR (PRESSURIZED) FREIGHT HOLD (TWO DOORS ST'B'D.)
FOUR ROLLS-ROYCE DART 510 TURBOPROPS (ROTOL AIRSCREWS)

fully compliant with C.A.A. regulations. Nineteen of these items were already met by the V.724, on which Capital's version was based, reducing the entire problem to one of incorporating seven fairly simple changes. The modifications made are summarized briefly below:—

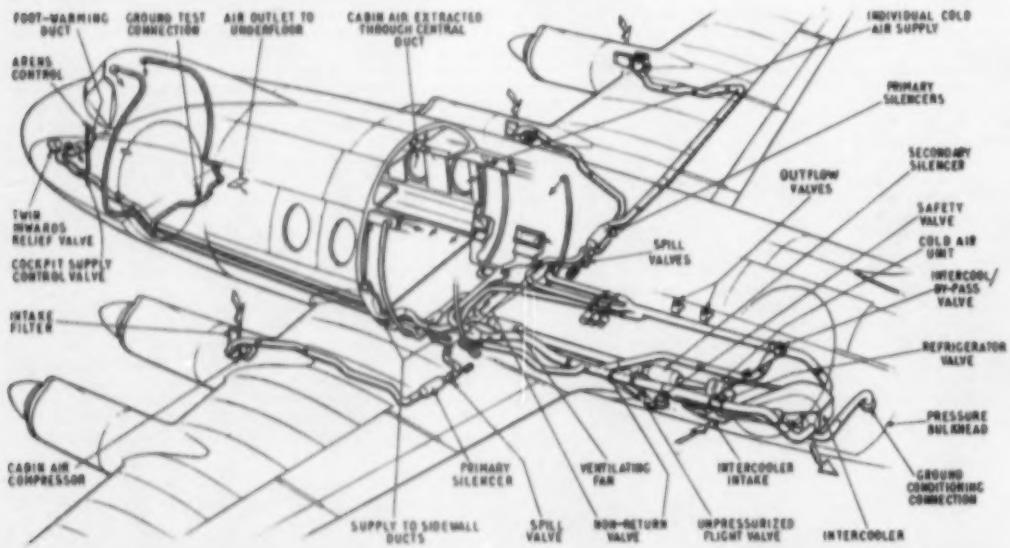
(a) Capacity of the water methanol tank increased from 74 Imp. gal to 110 Imp. gal; (b) rearrangement to American standards of the relative positions of certain controls and instruments; (c) installation of instrument markings and placards to C.A.A. requirements; (d) strengthening of the undercarriage to permit the aircraft to be landed, under certain circumstances, at an unusually high proportion of take-off weight (as an alternative to the incorporation of a fuel-jettisoning system); (e) strengthening of the windshield to resist bird-impacts at cruising speed, rather than climbing, speed at heights of up to 8,000ft (this requirement was met by the use of Nesa heated glass); (f) installation of a rotating anti-collision light at the tip of the fin and of two fuselage-mounted parachute flares aft of the pressure bulkhead; (g) incorporation of an additional safety device in the airscrew control system.

Agreement in principle on the United States certification of the Viscount was reached in November last year. The formal issue of type certificates for the aircraft, engines and airscrews then had to await completion of individual aircraft. The three relevant certificates for aircraft N7402, first of Capital's Viscounts, were issued in London on June 13th.

Formally handed over to the president of Capital Airlines, Mr. J. H. Carmichael, on May 17th, N7402 was ferried to the United States (with Mr. Carmichael on board) on June 16th. This aircraft and the two Capital Airline's Viscounts succeeding it on the Vickers production line are designated type 744s. Of the airline's remaining 57 machines, an initial batch will be Viscount 745s and the majority will be Viscount 745Ds.

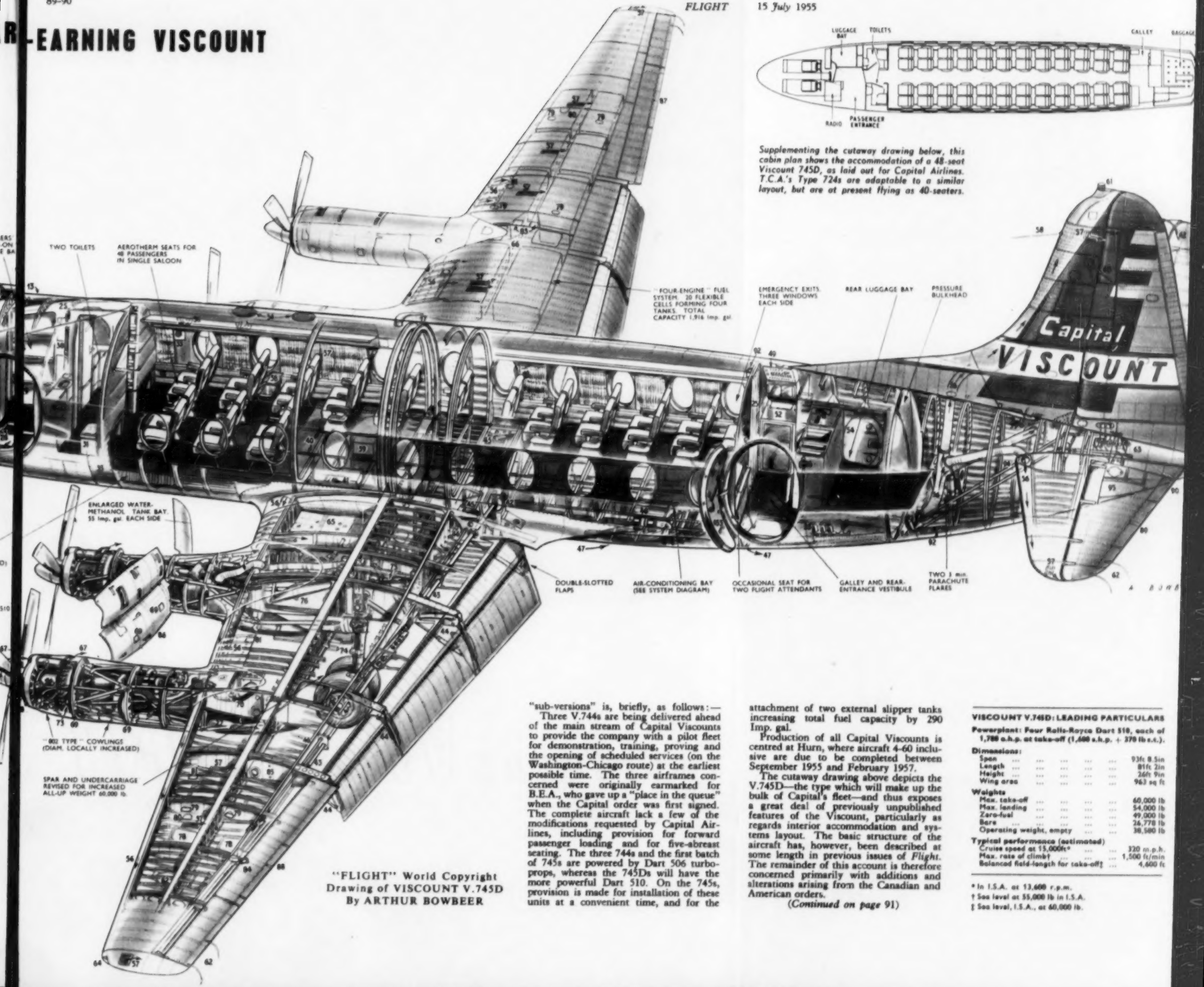
The difference between these three

(Below) Both T.C.A. and Capital Viscounts employ Airesearch automatic regulation of cabin pressure. Three engine-driven Roots-type blowers form the source of cabin air, delivering 75 lb/min at 20,000ft. The cabin is designed for a differential pressure of 6½ lb/sq in.



R-EARNING VISCOUNT

Supplementing the cutaway drawing below, this cabin plan shows the accommodation of a 48-seat Viscount 745D, as laid out for Capital Airlines. T.C.A.'s Type 724s are adaptable to a similar layout, but are at present flying as 40-seaters.


TWO TOILETS
AEROTHERM SEATS FOR 48 PASSENGERS IN SINGLE SALOON
"FOUR-ENGINE" FUEL SYSTEM: 20 FLEXIBLE CELLS FORMING FOUR TANKS. TOTAL CAPACITY 1,916 Imp. gal
EMERGENCY EXITS, THREE WINDOWS EACH SIDE
REAR LUGGAGE BAY
PRESSURE BULKHEAD
Capital
VISCOUNT
ENLARGED WATER-METHANOL TANK BAY. 55 Imp. gal. EACH SIDE
"902 TYPE" COWLINGS (DIAM. LOCALLY INCREASED)
SPAR AND UNDERCARRIAGE REVISED FOR INCREASED ALL-UP WEIGHT 60,000 lb.
DOUBLE-SLOTTED FLAPS
AIR-CONDITIONING BAY (SEE SYSTEM DIAGRAM)
OCCASIONAL SEAT FOR TWO FLIGHT ATTENDANTS
GALLEY AND REAR-ENTRANCE VESTIBULE
TWO 3 min. PARACHUTE FLARES

"FLIGHT" World Copyright Drawing of VISCOUNT V.745D By ARTHUR BOWBEER

"sub-versions" is, briefly, as follows:—

Three V.744s are being delivered ahead of the main stream of Capital Viscounts to provide the company with a pilot fleet for demonstration, training, proving and the opening of scheduled services (on the Washington-Chicago route) at the earliest possible time. The three airframes concerned were originally earmarked for B.E.A., who gave up a "place in the queue" when the Capital order was first signed. The complete aircraft lack a few of the modifications requested by Capital Airlines, including provision for forward passenger loading and for five-abreast seating. The three 744s and the first batch of 745s are powered by Dart 506 turbo-props, whereas the 745Ds will have the more powerful Dart 510. On the 745s, provision is made for installation of these units at a convenient time, and for the attachment of two external slipper tanks increasing total fuel capacity by 290 Imp. gal.

Production of all Capital Viscounts is centred at Hurn, where aircraft 4-60 inclusive are due to be completed between September 1955 and February 1957.

The cutaway drawing above depicts the V.745D—the type which will make up the bulk of Capital's fleet—and thus exposes a great deal of previously unpublished features of the Viscount, particularly as regards interior accommodation and systems layout. The basic structure of the aircraft has, however, been described at some length in previous issues of *Flight*. The remainder of this account is therefore concerned primarily with additions and alterations arising from the Canadian and American orders.

(*Continued on page* 91)

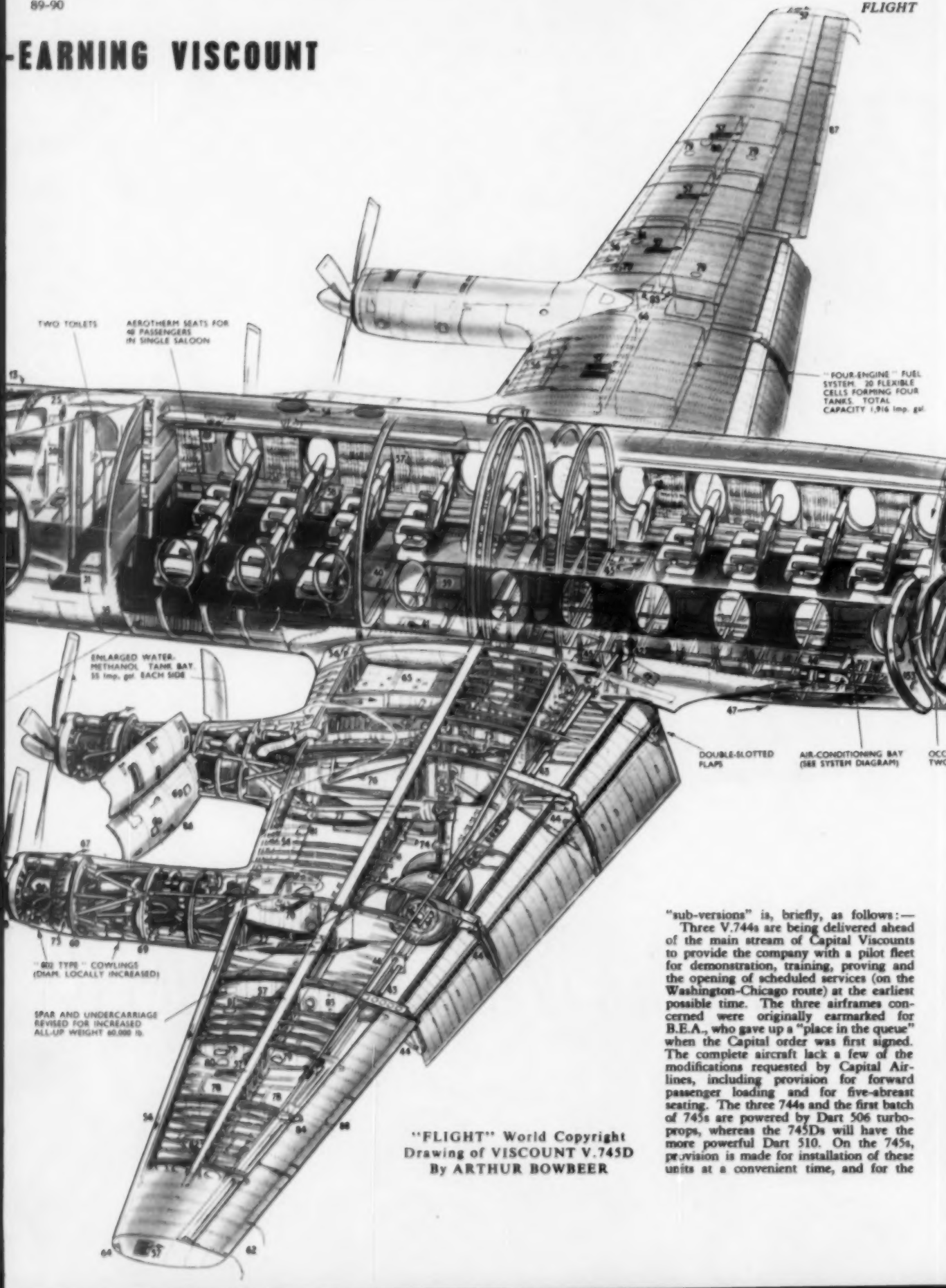
VISCOUNT V.745D: LEADING PARTICULARS

Powerplant: Four Rolls-Royce Dart 510, each of 1,788 e.h.p. at take-off (1,680 e.s.h.p. + 370 lb e.t.).

Dimensions:	
Span	93ft 8.5in
Length	81ft 2in
Height	26ft 9in
Wing area	963 sq ft
Weights	
Max. take-off	60,000 lb
Max. landing	54,000 lb
Zero-fuel	49,000 lb
Bare	26,778 lb
Operating weight, empty	38,580 lb
Typical performance (estimated)	
Cruise speed at 15,000ft*	320 m.p.h.
Max. rate of climb†	1,500 ft/min
Balanced field-length for take-off‡	4,600 ft

* In I.S.A. at 13,600 r.p.m.
† Sea level at 55,000 lb in I.S.A.
‡ Sea level, I.S.A., at 60,000 lb.

-EARNING VISCOUNT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ENLARGED WATER-METHANOL TANK BAY 55 Imp. gal. EACH SIDE
DOUBLE-SLOTTED FLAPS
AIR-CONDITIONING BAY (SEE SYSTEM DIAGRAM)
"602 TYPE" COWLINGS (DIAM. LOCALLY INCREASED)
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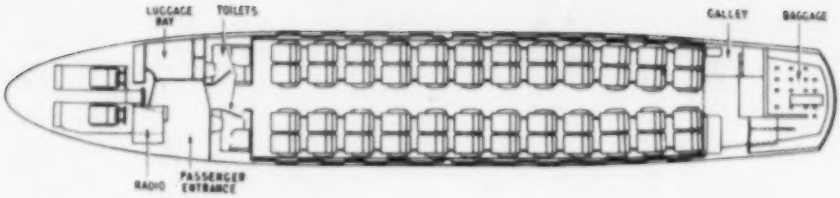

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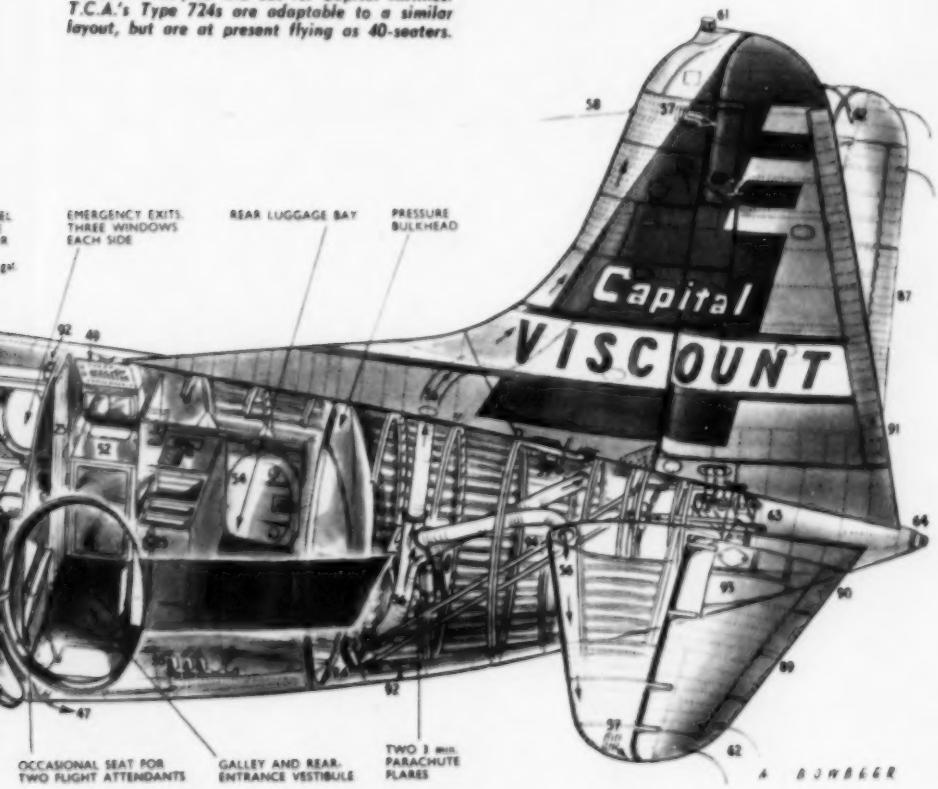

KEY TO DRAWING

1 Inwards pressure relief valve.
2 Access hatch to rear of instrument panel.
3 Warm air to cockpit.
4 I.L.S. "glide-slope" antenna under nose.
5 Triple static vents to instruments.
6 Single static vent to safety devices.
7 Pitot head.
8 Windscreen de-icing fluid pressure connection.
9 Nesa glass heated windscreens.
10 Triple windscreen wipers and alcohol sprayboxs.
11 Direct vision panels.
12 Cockpit pressure dome.
13 Unpressurized fairing.
14 Windscreen de-icing fluid tank.
15 Icing inspection lamp.
16 VHF (No. 1) aerial.
17 VHF (No. 2) aerial.
18 Nosewheel steering wheel.
19 Push-pull control columns (both permanent installations).
20 Aerotherm pilots' seats.
21 Rudder pedal units with toe-brakes.
22 Bendix PB.10A autopilot motor-group.
23 Main radio crate (some in underfloor freight hold).
24 Cockpit door.
25 Curtains.
26 Nosewheel steering cylinders.
27 Towing point (scissor-link released).
28 Step lights.
29 Crew fixed oxygen and, below, air-outflow grill.
30 Hydraulic cupboard repositioned.
31 Non-flushing type toilets.
32 "Ship's library."
33 Public address (Bendix), 22 speakers.
34 Duplicated A.D.F. aerials (Marconi 7092c).
35 Ice-guard.
36 Passengers' service panel under light luggage rack.
37 Sliding curtains (no sun blinds).
38 Chair-back tables.
39 Varley battery bay.
40 Seat rails.
41 Emergency exit external release, windows 4, 6 and 9.
42 Flap motor and gearbox.
43 Flap torque-tube and driving chains.
44 Flap guide-rails and radius arms.
45 Aileron control pressure seal.
46 Aileron control run.
47 Intercooler airflow (flush intake).
48 Cold air turbine unit (Airesearch).
49 Flight attendant's control panel.
50 Intercom. hand-set.
51 Conditioned air duct.
52 Galley equipment: Dry stores containers, tray carriers, hot food carriers, hot water jugs, hot cups, ice box, "carry on" fresh water tank.
53 Visual inspection panels over door-locking pins.
54 Baggage bay door.
55 Passengers' portable oxygen.
56 De-icing air to double-skinned leading edge of wing, fin and tailplane.
57 De-icing air outlets.
58 HF/Loran antenna (for ferry only).
59 HF/antenna release.
60 VOR and I.L.S. localiser antenna.
61 "Pounder" type anti-collision beacon.
62 Static dischargers.
63 Control locking system to withstand 80 kt. wind.
64 Navigation lights.
65 Tank bay linings perforated for rubber retaining studs.
66 Bag type fuel tanks.
67 Airflow through oil cooler.
68 Electric de-icing pads.
69 Firewall and fire access panels.
70 Fire suppression bottle, three spray rings in nacelle.
71 Rotol auxiliary gearbox on each engine driving Godfrey cabin blowers (three only), generators, hydraulic pumps, airscrew-de-icing alternators.
72 Cabin blower delivery duct (intake on nacelle inner flank).
73 Main engine mounting point.
74 Vickers 14 in. stroke undercarriage, Dunlop tyres, wheels, steel-disc brakes with Maxaret.
75 Retraction jack.
76 Retraction bay, and door linkage.
77 Jet-pipe.
78 Tank access panels.
79 Pacitor gauge covers.
80 Float-switch covers.
81 Gravity filling points (pressure refuelling below wing).
82 Landing lamp.
83 Access to outer-plane attachment bolts.
84 Irving-balanced split ailerons, skew-bar operated.
85 Nine ribs only in each wing, plus light chordwise members.
86 Outer flank cowling with hinged top section, inner carries lower cowling.
87 Trim tabs.
88 Balance tab.
89 Anti-balance tab.
90 Spring-servo tab.
91 Servo-trim tab.
92 First-aid kits external and internal.
93 Rear fuselage access door under tail.
94 Elevator control-run pressure seal.

attachment of two external slipper tanks increasing total fuel capacity by 290 Imp. gal.

Production of all Capital Viscounts is centred at Hurn, where aircraft 4-60 inclusive are due to be completed between September 1955 and February 1957.

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(*Continued on page* 91)

VISCOUNT V.745D: LEADING PARTICULARS

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Dimensions:	
Span	93ft 8.5in
Length	81ft 2in
Height	26ft 9in
Wing area	963 sq ft
Weights	
Max. take-off	60,000 lb
Max. landing	54,000 lb
Zero-fuel	49,000 lb
Bare	26,779 lb
Operating weight, empty	30,580 lb
Typical performance (estimated)	
Cruise speed at 15,000ft*	320 m.p.h.
Max. rate of climb†	1,500 ft/min
Balanced field-length for take-off‡	4,600 ft

* In I.S.A. at 13,600 r.p.m.
† Sea level at 55,000 lb in I.S.A.
‡ Sea level, I.S.A., at 60,000 lb.

"*The Viscount is a Dinger.*"
INTERNATIONAL NEWS SERVICE

"—formidable—"
AMERICAN AVIATION

"Quietness is a feature of the new Viscount."
NEW YORK JOURNAL-AMERICAN

"*The first British Plane to break the U.S.-built commercial plane monopoly.*"
INTERNATIONAL NEWS SERVICE

"There is almost no vibration."
NEW YORK JOURNAL-AMERICAN

"*The current production Viscount is a truly remarkable aircraft.*"
NEW YORK HERALD TRIBUNE

"The Viscount is Britain's greatest single commercial victory of the post-war years."
TIME MAGAZINE

"*'Quite an airplane,' you say to yourself. 'Quite an airplane'.*"
ALBERT M. SKEA, NEWARK EVENING NEWS

VICKERS VISCOUNT

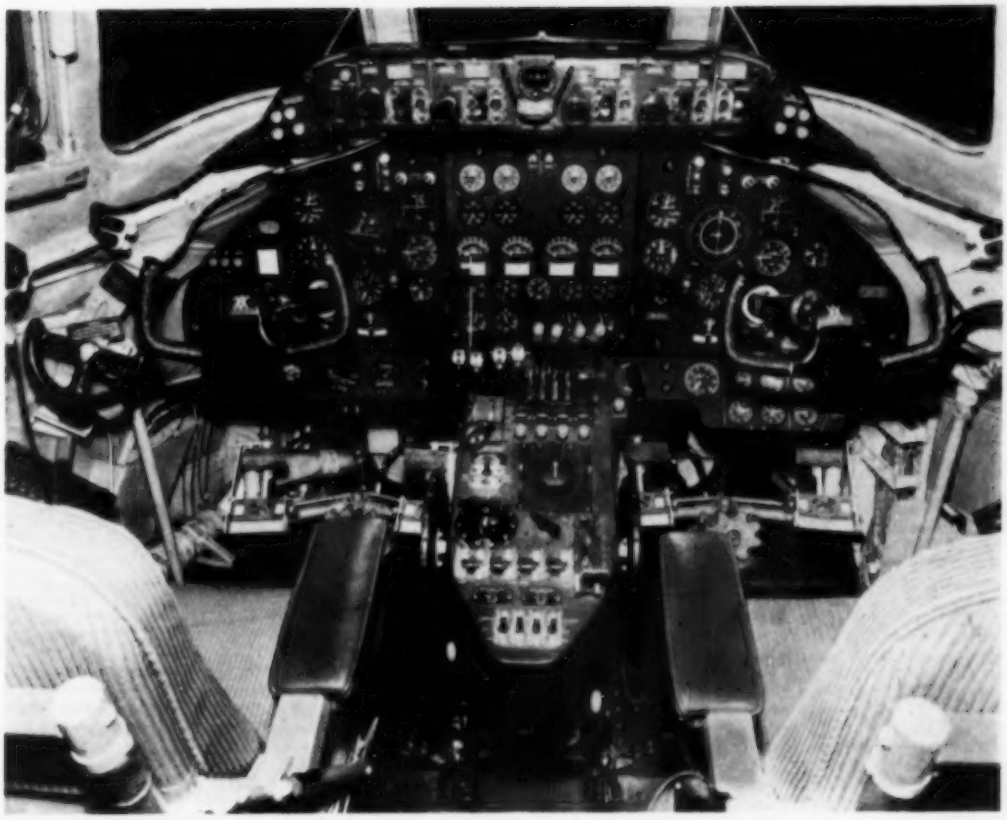
FOUR ROLLS-ROYCE DART PROPELLER-TURBINE ENGINES

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED · WEYBRIDGE · SURREY

VICKERS VISCOUNT

FOUR ROLLS-ROYCE DART PROPELLER-TURBINE ENGINES

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED · WEYBRIDGE · SURREY



Cockpit layout of this Capital Airlines Viscount (an early-mark V.744) is essentially as described below. Points of interest are the wheel-shaped undercarriage lever and the flap-shaped flap selector, both mounted on the central pedestal.

THE DOLLAR-EARNING VISCOUNT . . .

An important distinguishing feature of the North American Viscount is its flight deck, which has been entirely re-styled, laid out for two-man operation (B.E.A.'s V.701s are crewed by two pilots and a radio operator) and fitted with a high proportion of American instruments and aids. The new layout was developed jointly by Vickers and T.C.A., whose director of engineering, Mr. J. T. Dyment, expressed in a recent lecture his company's opinion that "the current Viscount cockpit is head and shoulders the simplest four-engined cockpit in the business"; the aircraft could be flown completely from either seat, and there were in the cockpit "approximately 145 fewer controls, switches, instruments and warning lights than in the most typical four-engined transports over here."

Most features of the Capital cockpit, which is based on that developed for T.C.A., can be seen in the photograph above. Between the pilots' Aerotherm seats is a pedestal containing, *inter alia*, power and fuel shut-off levers; water-methanol controls and indicators; Bendix PB. 10A autopilot (not fitted on T.C.A.'s V.724s); undercarriage and flap selectors; and trim controls.

The centre panel contains 20 Smiths Group and Sangamo-Weston engine instruments—showing the Darts' r.p.m., torque, jet-pipe temperature, oil-pressure and oil-temperature—and an outside-air-temperature gauge.

Instruments common to both captain's and co-pilot's panels include the A.S.I.; altimeter; vertical-speed indicator; radio-magnetic indicator and switches; clock; master direction indicator; turn-and-bank indicator; and airways marker lights. Captain and first officer are each provided with one of the two main presentation components of the Collins Integrated Flight System (*Flight*, February 11th, 1955), a relatively new aid to both *en route* navigation and final approach; these components are the approach-horizon indicator (left panel) and course-indicator (right panel). On the captain's sill panel (below dash) are hydraulic- and brake-pressure and undercarriage indicators; the starboard sill houses (left to right) engine synchronizer controls; fuel-flow indicators 1 and 2; four fuel-contents gauges; water-methanol gauges; and fuel-flow indicators 3 and 4.

Above the dashboard is the extremely neat fire-control panel, which has four protective flaps of transparent plastic to prevent inadvertent operation. Beneath each flap—one per engine—are the following items: fire-warning indicator, feathering switch, fuel shut-off valve, and methyl-bromide switch. Centrally mounted, between flaps 2 and 3, is a magnetic compass.

Above the windscreen is a roof-mounted electrics panel (not shown in the photograph). Its contents include the A.D.F. (duplicated), and controls for radio, pressurization, heating, de-icing and lighting. On the co-pilot's right is a second electrics panel, primarily for use of mechanics.

Both pilots are provided with toe-brakes and nosewheel steering, and a "stick-shaker" stall-warning indicator is fitted to the port control wheel.

Radio equipment specified by Capital for the V.745D is as follows: two Bendix V.H.F. transmitters and receivers; Marconi dual A.D.F.; Collins V.H.F. navigation and glide-slope receivers; Bendix marker-receiver and audio system.

Considerable effort was devoted to layout and design of the North American Viscount cabin. The result is in many ways an improvement on the cabin initially evolved for the B.E.A.-styled V.701 and adopted, with variations, by many other operators of the V.700-series Viscount. A notable instance is the installation of two toilets immediately behind the forward entrance-door in place of the single toilet in the tail. In consequence, galley positions have been reversed; the galley of the North American version is situated in the rear cabin, behind the rear vestibule, instead of between the cabin and the flight deck. Capital's V.745Ds will have provision for passenger loading *via* the forward door and—an increasingly popular and useful feature for modern short-haul operations—a "carry-on" luggage rack just inside this door.

Interior styling of both Capital and T.C.A. versions was the work of a New York design consultant, Charles Butler. Though the V.724 and V.745 interiors differ in detail, both feature extensive use of plastic materials and "neutral" colours—various shades of brown, green and fawn. In each case the seats employed are lightweight double chairs produced by the U.S. Aerotherm concern. T.C.A. are at present operating their V.724s on first-class services as 40-seaters, with ten rows of seats at 39in pitch. By the installation of 12 rows at 34in pitch passenger-capacity can be increased to 48 without recourse to the more cramped five-abreast layout employed in B.E.A.'s 47-seaters. Though there are only ten windows on each side of the cabin, the 12-row four-abreast arrangement has remarkably little effect on visibility, and the Aerotherm chair is designed to afford ample leg-room even at the reduced pitch. Passengers who have sampled both European and North American layouts have expressed their preference for the four-abreast version.

Capital Airlines may employ a 40- or 45-layout on their intro-

When not in use, the very compact galley of the V.744/5 is hidden from sight by a neat roller blind (left). At right is shown the pantry and sink. The steward's station also incorporates a control panel.

THE DOLLAR-EARNING VISCOUNT . . .

ductory Viscount services, but the majority of their new aircraft will almost certainly operate as 48-seaters. Provision is made on their V.745s and 745Ds for installation of five-abreast seating—presumably for "coach" services. All Viscounts now have the necessary seat-attachment rails permitting four- or five-abreast seats to be fitted at the operator's discretion, and the only modifications required in this instance were a two-inch movement of the "cornice" structure (to give more headroom to passengers on the window-side seats) and adaptation of the passenger-service panels installed at each side of the cabin.

A small but interesting item of equipment peculiar to the T.C.A. Viscount is its "potable water system." This, according to the airline's director of engineering, was fitted in order that "water from anywhere may be loaded into the airplane and pure water will come out of the tape." Mr. Dyment added: "This is accomplished by super-chlorinating the water in the system and then removing the super-chlorination and suspended material by carbon filters just before the water comes out of the tap. For those who are interested in such a system I suggest that they would be well advised to refer to the water system on the Viscount. In our opinion Vickers did a much better job than one of our American manufacturers in meeting T.C.A.'s requirements in this regard."

Mr. Dyment, who was addressing an S.A.E. meeting in New York, continued: "This might be an appropriate point to mention that we on this side of the Atlantic are inclined to believe that we can do most things in aviation better than those on the other side. T.C.A., who buys equipment from both, have found that no one has a monopoly on best design or best quality. We get good, and bad, equipment from both sides of the ocean. One example of the result of this experience is that while we use Godfrey cabin superchargers from England we use Airesearch pressurization controls from the United States. We think this particular combination is unbeatable at the present time."

The pressurization system maintains sea-level conditions in the cabin up to cruising heights of 15,000ft, or a "cabin altitude" of 8,000ft at an actual height of 30,000ft. Designed maximum differential pressure is 6½ lb/sq in. Any one of the three engine-driven blowers can maintain the full cabin pressure. In addition to regulating cabin pressure during the cruise, the Airesearch controller also regulates rate of change during ascent or descent, over a range of 100-1,000ft/min. To maintain cabin temperature at a comfortable level under abnormally cold conditions, T.C.A.'s V.724s are fitted with Janitrol combustion heaters, and Capital's aircraft have built-in provision for the installation of Janitrol, if required.

As illustrated on an earlier page, the fuel system was also re-worked to North American requirements. Previous V.700s employed a total of 18 tanks containing 1,720 Imp. gal of fuel. Each engine now has its individual tank, made up of a number of cells (three cells each for inboard engines, seven for outboards). Total capacity is 1,916 Imp. gal and the system is adaptable for use of kerosine or JP4 (wide cut gasoline); T.C.A. Viscounts run on JP4, but Capital, like other V.700 operators, use kerosine. On the American airline's V.745s, provision is made for attachment of slipper-type external fuel tanks, increasing total fuel capacity by 290 Imp. gal and still-air range by almost as many miles for a speed penalty of 4-5 m.p.h.

As mentioned earlier in this account, the major difference betwen the V.745 and V.745D for Capital Airlines lies in the type of Rolls-Royce Dart turboprop fitted. The three V.744s and the 745s, probably numbering a dozen or thereabouts, will have Dart 506s; the remaining 40-plus Capital Viscounts will be 745Ds, powered with Dart 510s.

Both versions of this famous turboprop are based on the Dart 505 which, in service with B.E.A. and other operators, has built up most of the 350,000-plus engine-hours flown to date in scheduled airline service. The characteristics of the three were summed up as follows in the recent lecture, *Operating Experience with Turboprop Aircraft*, given by B.E.A.'s chief executive, Mr. Peter Masefield, at Los Angeles:—

M.o.S. Desig.	Mark No.	Red. gear ratio (one to:)	Take-off power		Typical cruising power (e.h.p.)
			e.h.p. + thrust	e.h.p.	
R.Da.3	505	0.106	1,400 + 365	1,547	912
R.Da.3	505	0.106	1,400 + 365	1,547	1,002
R.Da.6	506	0.093	1,600 + 370	1,780	1,021

As recounted in *Flight* for January 14th, the additional cruising and/or take-off power obtained with the later Darts accrues from refinement of internal design. Use of a new reduction gear enables the Dart 510 to deliver additional power at take-off as well as in cruising flight, whereas the 506 offers improved power (and specific consumption) only in the cruise. B.E.A.'s Viscount 701s, incidentally, are being progressively fitted with Dart 506s instead of 505s, increasing their cruising speed by some 20 m.p.h. The V.724s now serving T.C.A. were the first civil aircraft to use the Dart 506, though some of the 26 Viscounts ordered by the Canadian airline will have 510s.

Capital's V.745/745Ds cannot be distinguished externally, because both types have the slightly fatter cowling developed for the long-fuselage Viscount 802 ordered by B.E.A. and also to be powered with the later-mark Dart.

Engine synchronization on both American and Canadian Viscounts is achieved with a Rotol automatic system which synchronizes both power output and speed, and is reported to be giving extremely good results.

In addition to the development highlights described above, the North American Viscount embodies a number of relatively minor airframe modifications. Too numerous to discuss here, these alterations range from cold-weather measures—such as the addition of fuselage ice-guards or seals of special "winterized" rubber—to features giving faster turn-round: e.g., replacement of screw-type by bayonet-type bulbs, and improved cargo lighting.

Modifications notwithstanding, the aircraft remains in essence and appearance a Viscount—an aircraft of British conception and construction. Its acceptance in North America marks the beginning of a new chapter in the already-promising ten-year history recorded elsewhere in this issue of *Flight*. With spares, Viscounts sold to North American operators will earn for this country about $100m—and many times this amount for their owners.

Design of the V.744/5 Viscount for Capital Airlines was based on that of the highly successful Trans-Canada V.724 illustrated here.

THE STORY OF THE VISCOUNT

(Continued from page 86)

was completed to the Ministry of Supply specification 21/49 of April 19th, 1950, and first flew, piloted by the present Vickers chief test pilot, "Jock" Bryce, from Brooklands aerodrome at Weybridge on August 28th, 1950. This aircraft, G-AMAV, was originally designed for a gross weight of 48,000 lb. It had a wing of five feet greater span than the V.630 (giving a span of 94ft) and its length was 6ft 9in greater (overall length: 81ft 2in). It is interesting to recall that this prototype was eventually flown by B.E.A. in the England-New Zealand Air Race of 1953 during which it took off in the Tropics at weights of up to about 65,000 lb —17,000 lb above the design maximum! It completed the 12,500 mile course in 40 hr 45 min, including flying non-stop from the Cocos Islands to Melbourne, 3,530 miles, in 10 hr 16 min at an average speed of 343 m.p.h.

While work had been progressing on the V.700, Vickers issued a new specification (91341) for this aeroplane in September 1949. This proposed three alternative interior layouts giving accommodation for up to 53 passengers. The gross weight was at first 48,000 lb but was later raised to 50,000 lb. The cruising speed was 310 m.p.h. The price was estimated as £160,000.

With the offering of the V.700 prototype B.E.A.'s faith in the Viscount, which had fallen to a low level as a result of the Corporation's recent economic assessments of the V.630, immediately revived. This design incorporated all the advantages of the "stretching" which had been advocated by them in the previous year. Estimates of its economic characteristics showed a marked improvement on the V.630.

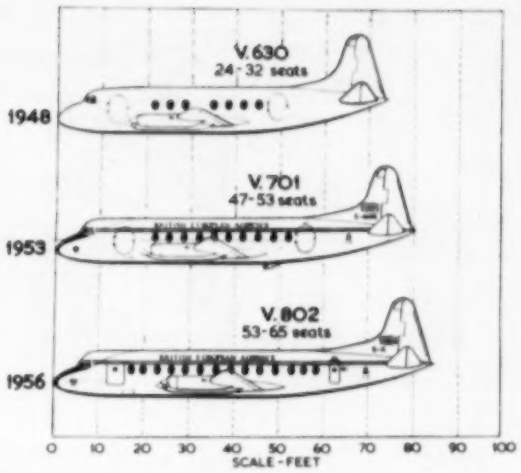
B.E.A.'s enthusiasm for the enlarged Viscount increased rapidly as a result of promising flight trials with the small V.630 prototype. At B.E.A.'s instigation this aeroplane gained a full passenger-carrying C. of A. on July 27th, 1950, and two days later was operated by B.E.A. on the world's first scheduled commercial passenger service with a turbine-powered aeroplane. From that date until August 23rd B.E.A. operated regular scheduled services between London and Paris and London and Edinburgh with this single aeroplane. In the course of 127 flying hours of scheduled operation in 26 days, during which 1,815 passengers were carried, the V.630 demonstrated in a convincing manner its attractions both to the traveller and to the airline operator.

On August 3rd, 1950, B.E.A. signed an order with Vickers-Armstrongs for 20 (later increased to 27) V.701 Viscounts. These were to be a slightly refined version of the V.700 prototype which was then on the point of flying. They were to have a gross weight of 53,000 lb, accommodation for 47 passengers in a five-abreast layout, and belly holds for increased freight capacity.

The B.E.A. order completely altered the future prospects of the Viscount and Vickers were able to start tooling for production. Further orders gradually accumulated from other operators until within two and a half years a total of some 40 more had been sold. Since then the rate of selling has increased rapidly and total sales now exceed 220. The Viscount has successfully established itself as one of the world's major transport aeroplanes.

The first production V.701 for B.E.A., R.M.A. *Discovery*, G-ALWE, first flew at Wisley on August 20th, 1952. It was delivered to B.E.A. on January 3rd, 1953, after all necessary development and acceptance tests had been completed. The V.701, as finally delivered to B.E.A., had a gross weight of 56,000 lb (later increased to 57,000 lb) and cruised at 302 m.p.h. at 23,000ft on 780 e.h.p. engine at 13,600 r.p.m. from its Dart 505 engines. Initially operation was normally restricted to 13,300 r.p.m. which gave a speed of 290 m.p.h. under mean conditions.

The Viscount V.701 gained its type C. of A. on April 17th, 1953 and first went into regular scheduled service two days later —eight years and one month after the first thoughts about the original VC-2 project in March 1945 and rather more than two years and eight months after B.E.A. had ordered the Viscount. Since then B.E.A. has brought 25 of its V.701s into scheduled service.



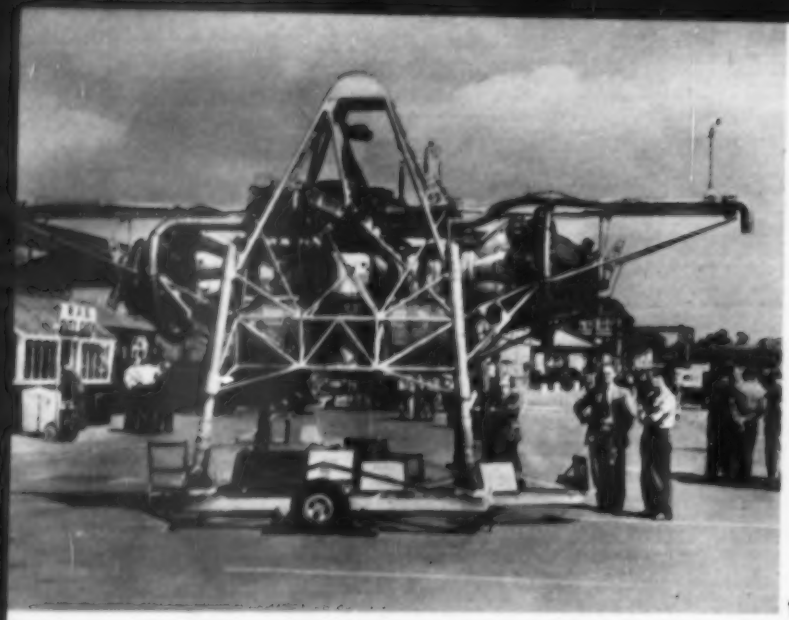
Length and capacity of the three basic types of Viscount airframes.

On February 11th, 1953, a contract was signed between Vickers-Armstrongs and B.E.A. for the construction of twelve V.801 aircraft—a larger development of the V.701. This aeroplane was to have had a gross weight of 65,000 lb and accommodation for up to 86 tourist (56 first-class) passengers in a fuselage 13ft 3in longer than that of the V.701. The engines were to have been the 1,690 e.h.p. Dart R.Da.5 and the speed was to have been rather less than the V.701's. The intention originally was to get these aircraft into service during 1955 but, after the placing of the original order, B.E.A. modified and developed its specification of requirements in consultation with Vickers-Armstrongs and taking into account developments in the Dart. As a result, a new contract for twelve V.802 Viscounts was signed on April 14th, 1954 to replace the earlier V.801 order. An option on a further ten V.802s was taken up at the same time and confirmed in March 1955. The 22 Viscount-Major V.802s will be delivered to B.EA. from October, 1956.

The V.802 is designed to take advantage of the R.Da.6 Dart 510 engine of 1,740 e.h.p. and will accommodate up to 65 passengers in a fuselage 3ft 10in longer than that of the V.701. Although the fuselage is only slightly lengthened the cabin capacity has been considerably increased by moving the rear pressure bulkhead 5ft 5in to the rear—giving a total increase in cabin length of 9ft 3in. The higher power of the Dart 510 and the savings in weight from the shorter fuselage are expected to give the V.802 a substantially higher performance than the V.801. Indeed, a mean cruising speed of 318 m.p.h. is projected. The economics are expected to show an improvement of 15 per cent over the seat-mile costs of the V.701.

The Viscount has thus progressed in ten years from the first design conceptions of 1945—for a 34,000 lb 24-passenger aeroplane cruising at 296 m.p.h.—to the Viscount-Major V.802 of today, designed for a gross weight of 62,000 lb with up to 70 passengers and cruising at 318 m.p.h. As the first turboprop aeroplane in the world to go into commercial service and the first British transport aeroplane to be operated by a United States domestic airline, its history is worth recording.

All airline Viscounts have developed from the V.700 prototype, shown here in the first of its numerous colour schemes.



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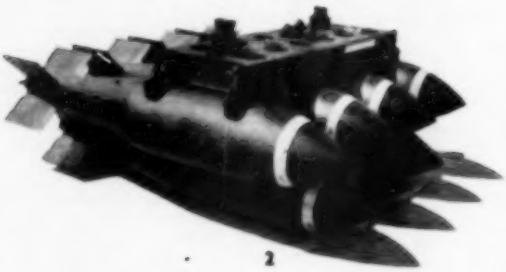
(1) *Less grotesque only than the "Cave-man Bomber" (page 76), the Rolls-Royce Nene-powered Flying Bedstead sits in the sun outside "A" Shed.*

(2) *A clutch of seven 1,000 lb bombs in their carrier, ready for loading in the Sperrin.*



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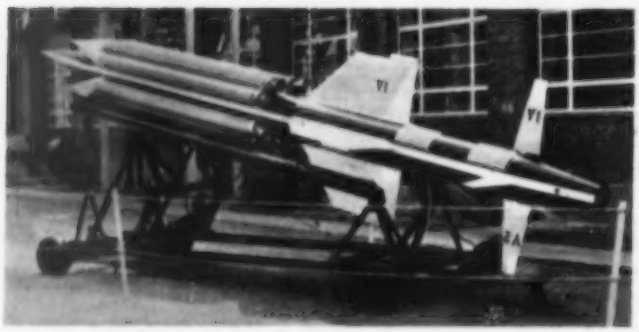
FARNBOROUGH AT HOME

Highlights and Sidelights of the Jubilee Celebration Described on Pages 74-75



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(3) *A "general-purpose vehicle," complete with boosters and incandescent traces, on its launching trolley outside the guided weapons laboratory.*

(4) *Two mechanical engineering exhibits, the partial-pressure suit (left) and experimental full-pressure suit, modelled by members of the department.*

(5) *Stream take-off of Nos. 54 and 247 Squadrons' Hunters in vic-3s.*

5

(6) *An admirably tight formation of Coastal Command Shackletons thunders over. Three of them are M.R.1s, the others M.R.2s.*

(7) *The Javelin free-fall model suspended under the cage of a captive balloon behind "A" Shed.*

(8) *A missile test-vehicle, one of many displayed in the workshops and laboratories of the Establishment. The cruciform wings are in the centre, with the guide vanes near the tail at right. The tapes lead up to descriptive panels above.*

(9) *The Sperrin on the compass-base near "A" Shed, ready to receive a 10,000 lb folding-fin bomb.*

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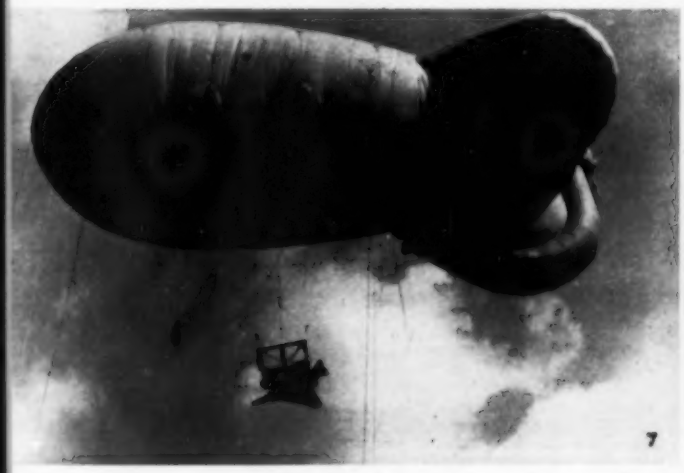

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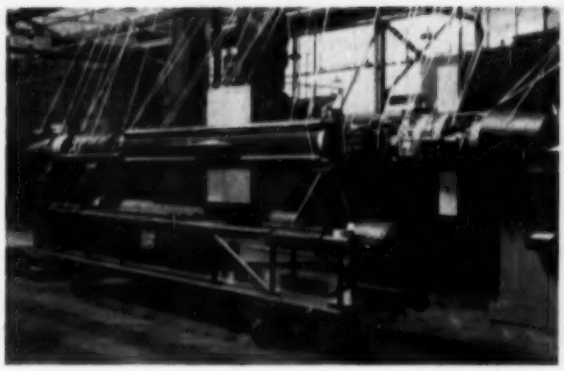
"FLIGHT" PHOTOGRAPHS



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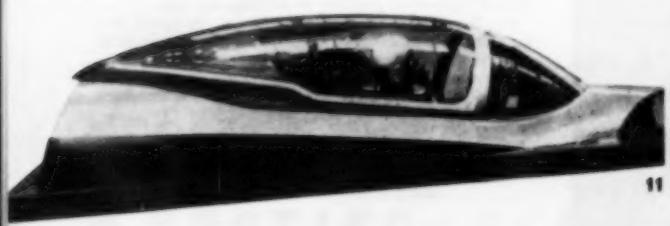
(10) *The automatic homing-radar aerial and associated equipment for a "general-purpose vehicle" designed to test missile automatic guidance.*

10

(11) *A fully transparent canopy, for the Swift Mk 4, which has to withstand aerodynamic stresses up to 30 tons.*

(12) *A well-polished exhibition version of the R.A.F.'s new 30 mm Aden revolver cannon.*



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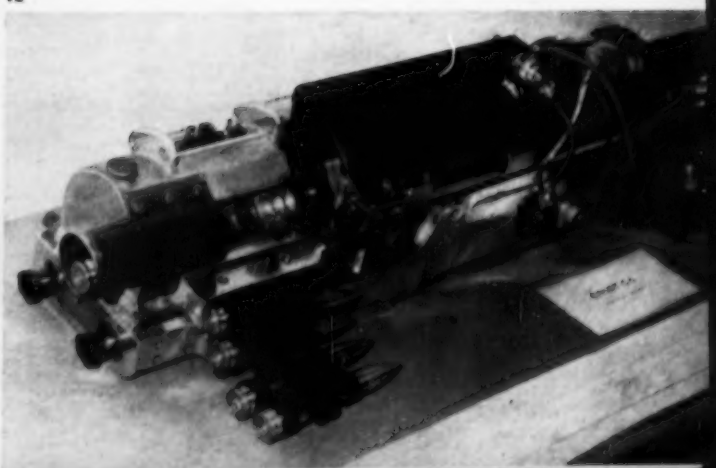

SYCAMORE in the Tyrol

By PETER MOORE

AS briefly recorded in "Flight" last week, a Bristol Sycamore took part in the recent helicopter convention at Stuttgart, then went on to give mountain rescue demonstrations in the Austrian Tyrol. In this article some highlights of the tour are described by the pilot. Mr. Raoul Hafner, Bristol's chief designer (helicopters), and Mr. Colin Harvey (assistant sales manager, rotating-wing aircraft) were present at the demonstrations; Mr. Alex Langfield (sales demonstration engineer) performed various strenuous duties as described; and Mr. D. Vickery was flight engineer.

The Sycamore gives a rescue demonstration near Innsbruck.

IT has often occurred to me that one of the most remarkable virtues of the helicopter—its ability to make auto-rotative landings—is not always fully appreciated. The value of this ability goes much further than ensuring a safe landing in the event of emergency. There are other operational advantages — particularly when flying, for example, in mountainous country, where it is advisable to keep all-up weight at a low value in order to be able to make controlled landings on ground at high altitudes. Knowing that he can descend quite safely without using the engine, the pilot can afford to reduce his fuel load considerably.

I must admit that, although I had occasionally considered this possibility, I did not fully grasp its significance until, the other week, I made a landing with a Sycamore at nearly 8,000ft on Hafelekar, a peak near Innsbruck in the Austrian Tyrol. High-altitude landings, it is true, are often in the news these days. Among the more recent was that of a Sycamore which landed at 10,000 feet in Kenya and flew a genuine casualty to safety. But the Hafelekar landing was, for a number of reasons, an unusually difficult one.

It was, I should explain, purely a demonstration landing, not one which had to be effected in the course of Service operations. It happened that I was pilot of a Sycamore which was flown to Stuttgart and Innsbruck after the Paris Salon, in order to demonstrate to German and Austrian authorities just what this Bristol aircraft can offer in the way of versatility and casualty evacuation from high points. Stuttgart came first—but that is another part of the story. The Hafelekar incident stands out in my memory as perhaps the most interesting landing and take-off that have ever come my way.

Our difficulty was that while, quite close at hand, there are a number of peaks which are even higher, yet offer landing grounds far more suitable than the one which we eventually chose, they are difficult of access for spectators.

On Hafelekar mountain the railway extends to a point near a kind of small plateau. In the middle of the plateau there was a patch of snow, the centre of which was the one spot where a landing was practicable. It was not particularly level, and in the normal way one would not contemplate putting a helicopter down there; but it was, all things considered, the most convenient for our purpose.

Before we tried the actual landing, Langfield and I made one or two reconnaissance flights. The flying conditions were about as awkward as anything I had previously experienced. The air around the peak of Hafelekar is a whirl of violent down-draughts—some of them reach a velocity of 1,000ft/min—and up-draughts which, unfortunately, are hardly so strong. On one side there is a steep rock face; on the other a sheer drop. Hovering, understandably, is difficult in these conditions and it is virtually impossible to make a normal approach. There is also the possibility that at the moment of landing one may receive unwelcome assistance from a sudden down-draught.

In these circumstances we decided that we would not in fact land before making the actual demonstration. And it was at this stage that we appreciated the value of auto-rotative landing. As soon as we had surveyed the patch of snow on which we were to land we simply slipped away over the edge and glided down, with the engine idling, to Innsbruck, five miles away in the valley.

When we made our landing on the following day, Langfield—by now adept at this kind of thing—was the "casualty." I took the aircraft up to a point well above the patch of snow, turned, and made for the touch-down point. In the event, it was easier than I had anticipated. With the rotors still running the "casualty," in excellent health, climbed aboard and we took off again. Once more the ground cushion was quite effective and I was able to slip over the drop and swoop down to Innsbruck.

One other pleasant memory of Innsbruck was the flight up the valley of the Inn—south from Rosenheim, and then due west—with massive peaks on each side of us, at times towering up to about 10,000ft. We flew mainly at about 4,000ft, keeping clear of the down-currents to windward.

At Stuttgart a few days before we had attended (in company with an S-51 and an S-55, three Bells, a Hiller, the S.O.1221 Djinn, and the Saro Skeeter) the three-day helicopter convention. We were particularly pleased with the part we played in the flying display, going through "at the double" a little set-piece which covered the ambulance rôle, passenger transport, winching a casualty aboard, descent from the aircraft by rope ladder, and carrying loads slung from a strong-point beneath the fuselage.

It was quite an effective way of emphasizing the rapidity with which the Sycamore can be converted from one rôle to another. We flew in with our stretchers aboard, picked up two casualties, flew a circuit, unloaded the stretchers and took on four passengers; another circuit, the passengers disembarked, and Langfield was winched aboard; and after a brief flight he threw out the rope ladder, then began to descend it while we were still at about 300ft! Finally, we hovered in the ground cushion while a load of oil drums was slung underneath, and made another circuit. Fifteen minutes covered the entire demonstration—quite a reasonable effort when it is considered that the stretcher cases and the men who loaded the oil drums were inexperienced at this kind of thing.

We also did a little night flying at Stuttgart. The German authorities were anxious to get our opinion of two new ground lighting systems; and we, with the crews of other helicopters, agreed to help. The first system consisted of a row of lights leading into a U-shaped fluorescent formation, with another row of lights leading out for take-off and two "horizontal" rows of red lights for levelling-off before beginning to climb. The second system consisted simply of two rectangles of lights, the outer one about 60 metres square, the inside one, indicating the touchdown point, considerably smaller.

Of the two, I preferred the first. The lights leading into and out of the U were most helpful, as also were the two rows of red lights. My only criticism is that the fluorescent lighting was too bright and was in fact something of a distraction. But this system, with the aid of the Sycamore's adjustable landing light, made night landing and take-off almost as routine as during the day.

My chief impression of the visit to Stuttgart was the alert and intelligent way in which the German authorities are approaching the helicopter.

In Austria, too, there is keen interest, with the accent, of course, on mountain rescue. We were able, in a British helicopter, to show how effectively the job can be done.

Making the approach to the snow-patch on Hafelekar, nearly 8,000ft above sea level.

FLIGHT,
15 July
1955

The fresh outlook on military pilot basic training

THE ATTRIBUTES OF THE JET PROVOST INCLUDE . . .

Side by side seating	The proven superior arrangement for all stages of flying training.
Docile handling	Essential in the early stages of a pupil pilot's training, and desirable thereafter.
Slow approach and Short landing	To give the pupil pilot confidence and to permit the continued use of existing training airfields.
Economy of operation	Jet techniques are taught from the start thus obviating the need for so doing in the expensive advanced trainer.
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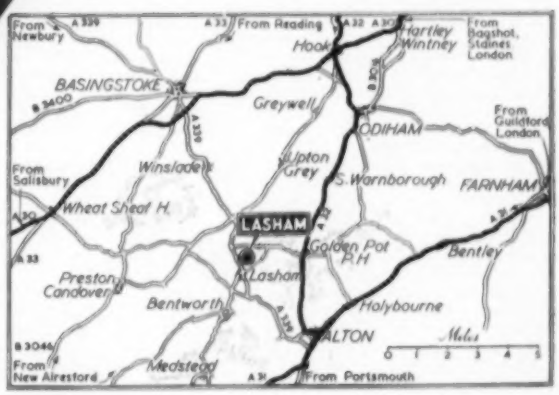
116.

LASHAM PROSPECTS

A Preview of the 1955 National Gliding Championships in Hampshire

Lasham Airfield, with the main E.-W. runway in the foreground. On the perimeter are the clubhouse and the glider hangar. The map shows the airfield location.



GIVEN good weather, this year's National Gliding Championships—at Lasham, Hampshire, from July 23rd to August 1st—should prove an exceptionally interesting meeting. For the first time since before the war the contests are being held in the South of England, and launching of the competing sailplanes from Lasham's flat site will be entirely by aero-tow. At the time of going to press 41 entries (listed below) had been received.

The competition début of the Slingsby Skylark II will take place at the championships, six of this type having been entered. These include the prototype of the Mark II flown by Frank Foster (and described by him in an article overleaf). An absolute newcomer is the Skylark III entered by F. N. Slingsby himself and to be flown by Tony Deane-Drummond. Main differences seen in the Mark III are increased span (59ft) and aspect ratio (20 : 1) and an associated increase in area of fin and rudder.

It is hoped that the Skylark III will be ready in time for the competitions. The same hope applies to the modified Olympia (No. 28) entered by the R.A.F.G.S.A./Wessex Gliding Club in the open team class. An extended and modified Perspex canopy, 6ft in length and based on a design suggested by A. Cdre. G. J. C.

ENTRIES

No.	Aircraft	Entrant	Pilot
Individual Class (Open)			
1	Olympia 4	H. C. G. Buckingham	D. Ince
2	Skylark II	Dr. O. J. C. Cotton	J. L. Cotton
3	Kite IIA	A. Coulson	A. Coulson
4	Olympia	C. W. Dowdall, W. Kahn and D. Scallon	C. W. Dowdall
5	Skylark II	F. Foster	F. Foster
6	T.42 Eagle	Hulton Press	L. Welch
7	Olympia	J. V. Inglesby	J. V. Inglesby
8	Sky	London G.C.	D. A. Smith
9	Skylark III	F. N. Slingsby	A. J. Deane-Drummond
10	Olympia	D. A. Smith and G. H. Stephenson	C. A. P. Ellis
11	Weihe	Surrey G.C.	W. A. H. Kahn
12	Olympia	Surrey G.C.	D. C. Kerridge
13	Sky	P. A. Wills	P. A. Wills
14	Olympia	Mr. and Mrs. D. O. Burns and *Junior Mirror*	A. D. Piggott
Team Class (Open)			
15	Skylark II	Army G.C.	D. Macey, P. W. Ball
16	Skylark II	Army G.C.	C. G. Dorman, E. G. Shepherd
17	Olympia	Bristol G.C.	J. M. Hahn, J. D. Jones, D. Stowe
18	Skylark II	Cambridge Univ. G.C.	A. L. L. Alexander, G. S. Neumann, G. R. Whitfield
19	Olympia	Cambridge Univ. G.C.	K. E. Machin, D. R. Clayton, D. D. Carrow, G. A. Hookings
20	Prefect	Cambridge Univ. G.C.	G. C. Hudson, P. J. Neilson, V. S. Pollard
21	Olympia	Derby and Lancs G.C.	P. Rivers, R. Dickson
Team Class (Open)			
22	Skylark II	Imperial College G.C.	W. N. Tonkyn, D. P. L. Scallon
23	Olympia	London G.C.	J. Simpson, H. Fursman
24	Olympia	Southdown G.C.	W. F. Jordan, D. C. Snodgrass, J. H. Holder
25	Olympia	Surrey G.C.	S. Morrison, C. Wills
26	Olympia	R.A.F.G.S.A./Wessex G.C.	P. Kearon, C. Scorer
27	Olympia	R.A.F.G.S.A., E. Midlands G.C.	C. M. Harcourt, W. D. Campion, D. A. Macdonald
28	Olympia	R.A.F.G.S.A./Wessex G.C.	A. Gough, L. Eldridge, G. Smith, G. Taylor
29	Gull IV	R.A.F.G.S.A./Moonrakers G.C.	K. C. Fitzroy, S. Wells
30	Sky	Empire Test Pilots School	P. L. Bisgood, E. D. Blake
31	Olympia	Empire Test Pilots School	A. W. Bedford
32	Sky	E. J. Furlong	E. J. Furlong, G. H. Stephenson
33	Olympia	G. C. Varley and R. C. Stafford-Allen	G. C. Varley, R. C. Stafford-Allen
34	Olympia	A. H. Warminger	A. H. Warminger, B. Gould
35	Olympia	A. H. Yates and G. H. Lee	G. H. Lee, A. H. Yates
T-21B Sedbergh Class			
36	T-21B	R.A.F./A.T.C. Home Command Gliding Instructors School	R. C. Jones, R. Williams
37	T-21B	R.A.F./A.T.C. No. 89 G.S.	F. R. E. Hayter, J. C. Allan
38	T-21B	R.A.F./A.T.C. No. 142 G.S.	W. Verling, D. E. Varney
39	T-21B	R.A.F./A.T.C. No. 188 G.C.	L. Radshaw, R. Porter
40	T-21B	Imperial College G.C.	P. Murden, P. Minson
41	T-21B	Midland G.C.	J. H. Hickling, A. F'kup

LASHAM PROSPECTS . . .

Paul, is being constructed for this machine by Elliotts of Newbury. The canopy will form one continuous curve from wing to nose, and the new Olympia will also incorporate a revised layout of instruments.

Two new sailplanes flown at last year's World Championships are appearing again in the Lasham contests. These are the Olympia IV, an experimental laminar-flow aircraft with which Elliotts are collecting data for use in the design of a forthcoming two-seater (and which was flown by Geoffrey Stephenson at the recent French national contests); and the Slingsby T.42 Eagle, entered by Hulton Press and being flown solo, on this occasion, by Lorne Welch (the record cross-channel flight by Welch and Irving in this sailplane was described by them in *Flight* of June 17th this year).

The remaining entries in the "open" section include four Skys and 17 Olympias—and also, a David among its high-performance Goliath brethren—a Prefect entered by one of the Cambridge University club teams. In the T-21B Sedbergh class, there are four Service and two civilian entries.

The list of pilots shows that Geoffrey Stephenson, flying in the team class with John Furlong, is not defending his British National Championship title this year. Among the pilots, in addition to the well-known names of Wills, Welch, Stephenson and others, are an increasing number of younger pilots (the youngest being 21-year-old John Cotton). Bill Bedford, Hawker test pilot, is flying the E.T.P.S. Sky; and Derek Piggott, Lasham chief flying instructor, is competing in the individual class for the first time.

Admission for spectators will be 2s 6d, and for children 1s. Car charges will be £1 for the special enclosure, and 2s 6d in the car park. Motor-cycle parking will cost 1s. A good route by road from London is along the A.30, turning left at Hartley Wintney on to B.3016, joining A.32 at Odiham and turning right at the Golden Pot. There will be A.A. signposting to the championships.

If the amount of preparatory work put in by the members of the Surrey Gliding Club group at Lasham is any measure, the competitions should be extremely successful. We can only hope that those taking part will experience weather of a considerably better kind than that at Camphill last year.

THOUGHTS on SKYLARKING

Flying and Enjoying Slingsby's Latest Single-seat Sailplane

AT gliding clubs throughout the country the sight of Slingsby's Skylark II sailplane is becoming an increasingly familiar one. This new high-performance design is proving extremely popular and its performance in the forthcoming National Gliding Championships will be watched keenly. The author of this article, owner of the prototype Skylark II, is a member of the London Gliding Club and was one of the British team in the World Gliding Championships of 1952. He is by profession an airline pilot, flying Elizabethans with B.E.A.

By FRANK FOSTER

DURING last year's International Gliding Contests, the remark was overheard that there were "only two sailplane constructors with their feet on the ground." An inept remark if taken literally, but apt enough in the spirit in which it was meant. Among the exotic and refined sailplanes at Camphill, though not competing, was the Skylark II, approaching in performance its more sophisticated brethren yet remaining a practical working sailplane—and illustrating again the established fact that its designer, F. N. Slingsby, is indeed well worthy of his place among the thin ranks of those who might be termed "realistic" sailplane constructors.

The need and demand for a relatively small yet high-performance single-seater had been felt for some time, and the general introduction of wing sections with good laminar flow made such a machine possible. As a result, the 45ft-span Skylark I was conceived and was brought out early in 1953. It also flew in that year's National Championships. Its performance at the higher speeds was remarkable and the quality of its controls set a new standard among current sailplanes. Rate of roll was such that many light-hearted pilots executed aerobatics which, I am sure, were not expressly approved in its C. of A.

This first Skylark suffered from one great drawback, however, owing to its high stalling speed (by sailplane standards) of about 40 m.p.h. A sailplane, of course, does much of its height-seeking by circling in thermal up-currents which are of limited size, and the Skylark's comparatively high circling speed meant that its turning circle was too large for the sailplane to stay within the heart of the average thermal.

Thus was born the Skylark II. With an extra three feet on the span and a chord wider by six inches, together with an improved semi-monocoque fuselage, the story was much better. For a very small sacrifice at high speed, the stall was down to 34 m.p.h., while the other pleasant handling features remained substantially as before.

Design Features.—The Skylark II is a high-wing cantilever sailplane, 48ft in span and 24ft 6in in length. Except for small areas of the wing, elevator and rudder, it is plywood-covered. Constructional materials are mainly spruce and gaboon ply with mixed use of steel and light-alloy fittings. The high-aspect-ratio wing (just over 17 : 1) consists of three sections and, in order to retain good flow characteristics, the ply is kept unbroken to a position well aft of the main spar. The benefits of this wing compared with the normal two-piece wing are a cleaner centre-section/fuselage joint and lighter fittings.

Against these advantages is a rather heavy lift when rigging. The job can be done by two people but is more easily performed with three or four. Speed of rigging and assembly is high and ten minutes is ample for this operation, as many of the fittings are self-aligning. For example, the outer wing, 14ft in length, is held by a single pin which carries bending loads and also holds the drag and anti-drag fittings in contact, in addition to the lever arms for the aileron operation.

The ply-covered ailerons are mass-balanced. This, together with what might be called a modernized and improved Frise-type aileron, doubtless has much to do with the positive snap of this control right down to stalling point.

Flying the Skylark.—From the launch, the Skylark climbs as a sailplane really should. With trimmer neutral, a slight back-pressure on the stick is needed to maintain the correct climbing attitude. In my opinion, launch hooks should always be so placed as to demand this slight back pressure. If no stick force is needed the machine usually "snatches itself" into a steep climb which, with an inexperienced pilot, could lead to a broken cable at an uncomfortable height and attitude.

Once off the launch, use can be made of the very effective trim-tab to fly at minimum sink, at an estimated speed of 42-43 m.p.h. The balance of all controls is good. Elevator, ailerons and rudder are all of similar power and are light but possess that feel of "rightness" which indicates what one is doing with the machine. If any one control is lighter than the others it is the rudder, but only the most fastidious pilot would claim that the controls were not definitely harmonized.

The stability of the machine is positive in all axes, but most marked fore-and-aft. When allowed to fly herself out of the dive, the Skylark rapidly damps out the phugoid motion and settles at the trimmed speed. Directional stability, however, is not quite as decisive. During turns on instruments this lack of more positive directional stability is, in my opinion, a weakness (but

The author with the prototype Skylark II at Kidlington during the Easter flight referred to on the next page.

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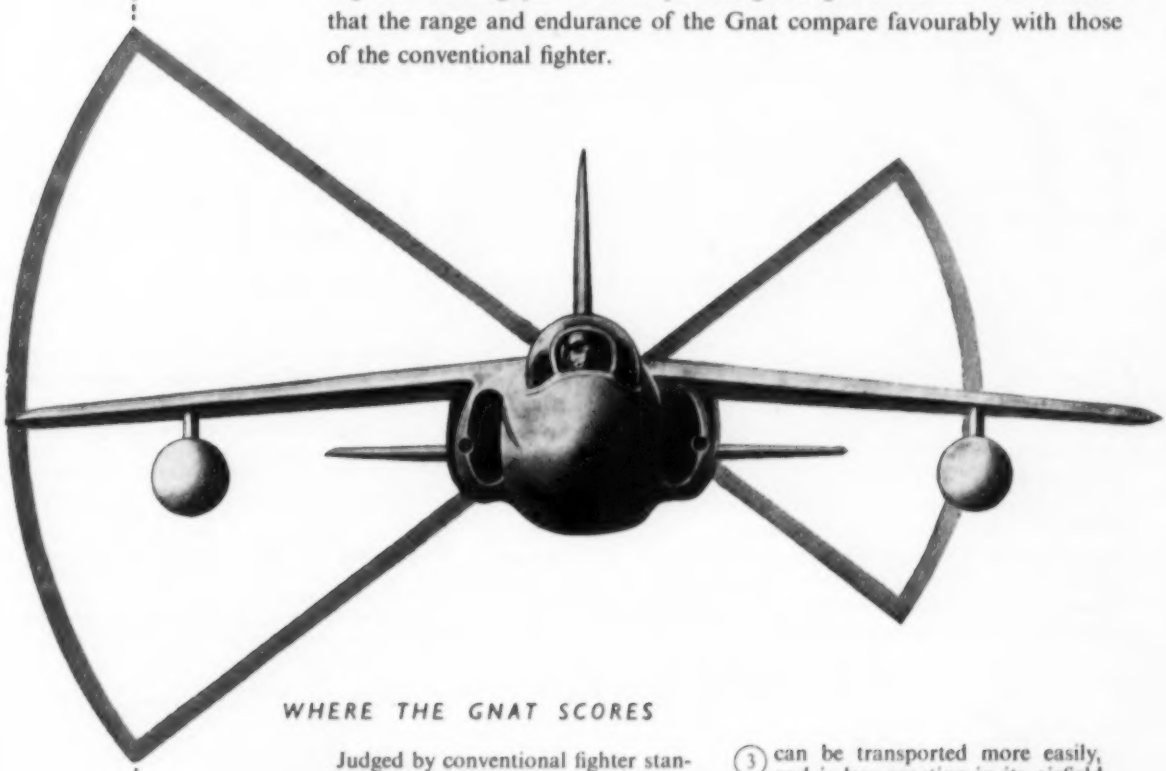
In terms of military load and fuel carried, a comparative weight analysis shows that the Gnat has an advantage of some 8% over the conventional fighter. This advantage is gained from the compactness and simplicity of its structure and equipment, and the singularly high thrust/weight ratio of its engine. Utilising part of this percentage weight bonus for fuel ensures that the range and endurance of the Gnat compare favourably with those of the conventional fighter.



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(4) is easier to produce.

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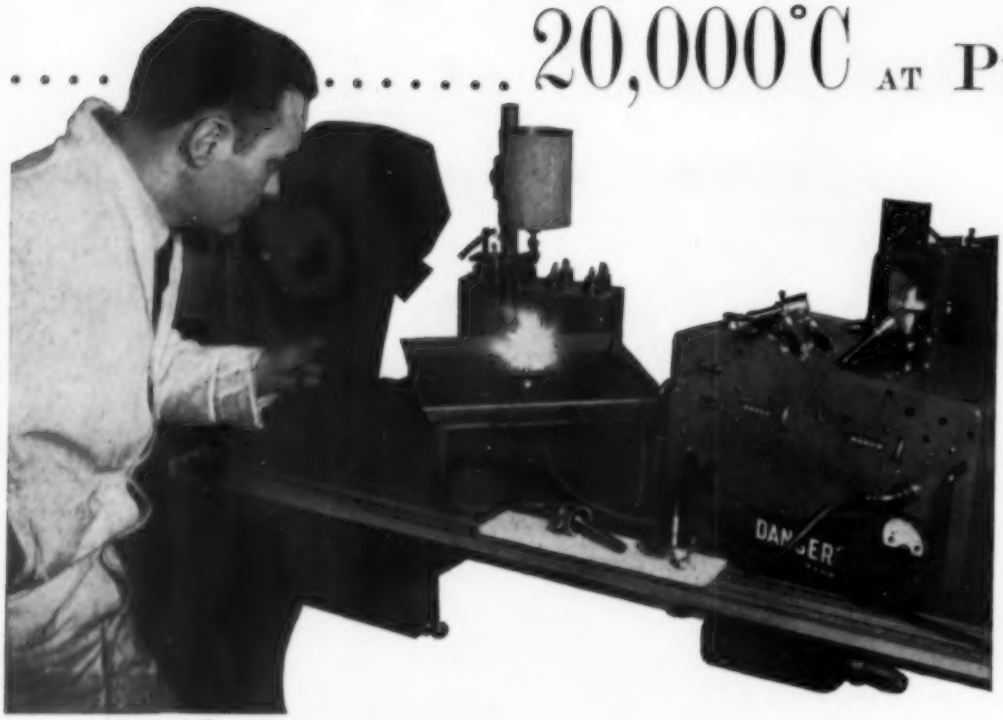

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THOUGHTS ON SKYLARKING . . .

perhaps an airline pilot becomes lazy after the almost solid directional stability associated with large modern powered aircraft).

During medium turns, all the stabilities become less marked and, perhaps due to the slight directional weakness and tendency to weathercock in a slip, speed control does require a little care if one has to circle tightly in a rough thermal. A check on accuracy in one particular turn indicated that not only was I holding off bank, but also had a suspicion of opposite rudder when maintaining a slip- and skid-free turn at a steady speed.

On Easter Saturday last, armed with but little knowledge of the Skylark's ways—apart from the fact that she looked right and, on short trips, had felt right—we attempted an out-and-return Dunstable-Kidlington flight (34 miles each way and the London Gliding Club's task flight for that day). The outbound leg, with a wind of 290 deg/20-25 kt between 2,000 and 5,000ft, was no sinecure. However, we launched straight into a good thermal which took us straight up to cloudbase—or at least up to that point where, to inhabitants of the London Control Zone, discretion says stop. The total-energy variometer, however, showed no life at all during this climb—a most annoying start. After considering the safety implications of mid-air repairs, I unscrewed the instrument panel (anchored by knurled nuts), removed the kink from the guilty air-tube and replaced the panel. The result was a permanent indication of 12ft/sec climb—a glider pilot's Utopia! I gave up and transferred my attention to the spare instrument, which was a Kollsman; a good instrument but not of total-energy type nor as responsive as the Horn.

Just after noon, I passed abeam the clubhouse and clocked myself out by jotting down the time, speed (60 m.p.h. indicated) and height (3,500ft). A straight glide to just beyond Ivinghoe Beacon enabled me to see one sailplane sitting on the disused airfield at Cheddington. Caution seemed to be advised. I slowed down to fly at minimum sink and, with one eye on the Chilterns as a hill-soaring retreat, searched for lift on the lee side of the airfield runways. It did materialize, but not before I had lost height to some 1,000ft above the ground—rather too low for comfort when cloud base is above 4,000ft.

The thermal was a good one and, being in what I consider my own blind-flying area, a small wedge of free air between airways Amber One and the rarely used Blue One, I rode serenely up to 6,000ft. Flying on instruments in the cloud, I needed to be especially careful for, not being used to the power of the light controls, I found it noticeably easy to over-correct. We pressed onward happily until Oxford was beneath. Here the mistake was made, for the clouds ahead were rather ragged and producing only marginal lift. Anxiously I pushed on, to find no lift at all at the turning point. Kidlington, however, was full of gliding friends and so my regrets were few after landing—at least until Geoffrey Stevenson's Olympia came gracefully overhead at 3,000ft and set course back to Dunstable.

The following Thursday dawned as one of those days when a "high" was set over the country, giving north-easterly winds in the Eastern Counties. It seemed a possible day for flying the classic "Wills route" to Plymouth. I was towed behind the club Tiger Moth to the desired starting point north of Luton. My target of 186 miles (300 km) was a long way and so I decided on nothing less than 60 m.p.h. and 5ft/sec thermals while above 3,000ft. (Optimum flying speeds for the type have not yet been computed but, from comparative flying alongside the 60ft span Sky, best speeds for the Skylark would appear higher in all but marginal lift conditions).

Man proposes and gravity disposes. At 2,000ft I put away theory and accepted what came my way. The first hour's flying was hard work with bitty thermals and marked sink in every gap between the 5/8 cloud. This happened in spite of using what seemed to be the best area, tracking along the escarpment of the Chilterns. During the second hour, conditions improved and the ground covered was 40 miles as against 30 in the first hour (tail-wind component at height, 10 kt).

Thermals were "dry" and small, however, with few clouds to act as markers. Here the Skylark really showed its mettle for, with its high rate of roll, one could quickly "centre" in the thermals.

The feeling of winding into good lift, and that slight g as the machine responds to 15-second circles, are joys known only to the sailplane pilot. For gentle circling in the Skylark 42 m.p.h. I.A.S. is a comfortable speed while, with an extra 5 m.p.h., I found it happy in the steepest of turns and in moderate turbulence. For a pilot weight of 170 lb, the stall occurs at 34 m.p.h. indicated, before which the machine grumbles gently and sinks noticeably at any speed below the 40 m.p.h. mark.

During the flight an inversion at 5,000ft prevented me from exceeding this height. Conditions, however, remained fairly good, thermals being frequent and of an average strength of 4ft/sec. After crossing Salisbury Plain and risking being taken for a target over the firing area, I found a change in conditions. By Yeovil the amount of smoke in the air was such that I was virtually flying I.F.R. It seemed as though I had flown into the downwind murk of London, trapped by the inversion and circling around the anti-cyclone. Twenty miles farther, clearer conditions were found and smoke from a chimney told me that, at least in the lower 1,000ft, the wind was south of east.

"The feeling of winding into good lift, and that slight g as the machine responds to 15-second circles, are joys known only to the sailplane pilot. For gentle circling in the Skylark 42 m.p.h. I.A.S. is a comfortable speed . . ."

The feel of air as smooth as silk and the absence of cumulus told their own tale: the circulation was sufficiently off the sea to be stabilized. Rather than risk stretching a glide to its limit (which sometimes means foolishly beyond it) I chose the disused airfield at Dunkeswell, which showed some signs of life, and landed to a welcome from the senior officer of the Home Office store there. Total distance flown had been 138 miles. A bare three and a half hours later my wife Pat arrived and reported that, with the new trailer and map-reading by eight-year-old daughter Carol, it had been impossible to go wrong on the retrieving trip.

The next planned trip in the Skylark was to attend an air rally at Denham, where "a few aerobatics if possible, please" had been requested. Aerobatics with the lively and powerful controls of the Skylark are a pure pleasure, although one's first loop is apt to be a little clumsy. Even with the use of trim, the longitudinal stability assists in bringing the nose up and over rather faster than intended. The spin is a definite one; and, with stick back and full rudder, the machine stays in it, nose down and with speed constant at about 50 m.p.h. Opposite rudder and easing of the backward pressure on the stick brings her out instantly and positively on any desired heading. With a little practice, also, stall turns can be most cleanly executed, all controls remaining crisp up to and even beyond the point of stall.

On her first solo flight in the Skylark, Pat found the controls too lively for comfort. Doubtless this will be the first reaction of many glider pilots used to poorer things; this feeling is soon overcome, however, if the machine is allowed to help to fly itself.

The future of the Skylark and its further development appears most exciting and this year's National Gliding Championships, in which several of the type are competing, should demonstrate its merits to the full. In the practical high-performance single-seater class, the Skylark seems to me to be an ideal choice.

HILLER RESEARCH

A NEW division for advanced research is being established by Hiller Helicopters, of Palo Alto, California. "For some time," says Stanley Hiller, Jr., "we have been aware of the growing need of letting our scientists and research engineers work in surroundings completely free from conventional thinking of the past. Recent aircraft developments such as the wingless Flying Platform and other projects, still classified, reveal the almost unbelievable possibilities of future flight, but the key to achieving what we now believe is possible lies in attaining an atmosphere in which new theories may be cultivated, and new ideas worked out."

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Soviet Flapping Wings

AT the Soviet Air Day in Moscow on July 3rd the appearance of a "glider with beating wings" was reported, which the Russians have claimed to be the "first" of its kind in the world.

It would be interesting to know if they have unearthed the plans of an earlier model which actually flew before the revolution. A great-uncle of mine, Count Youri Golovkine, invented just such a flying machine during the 1914-18 war. He was a young cavalry officer who transferred to the Imperial Russian Flying Corps as a result of a keen interest in aircraft design.

The machine in question, which was called the Golovkine ornithopter, was built in 1915 at government expense and given official Army trials in 1916. The principle on which it worked involved slots controlled by valves which closed on the down-beat and opened as the wing was raised. The power was entirely manual.

Plans were actually approved for a production order of 14,000 of these ornithopters to equip a full division, but the revolution intervened. Count Golovkine left Russia in 1919 with the designs of his machine, but was unfortunately drowned while sailing in the Bosphorus in 1920.

London, S.W.1. Y. GALITZINE.

[An interesting thought; but details so far available—see p. 846, *Flight*, June 17th—suggest that the new glider has little connection with the ornithopter principle.—Ed.]

They Also Served . . .

THE Battle of Britain will soon be in the news again and it hardly seems fifteen years ago that it took place. During that time Biggin Hill has been boosted until the younger folk really believe that it was the only airfield that mattered. How often are the stories of Manston, Hawkinge, Lympne, Detling or West Malling told? Yet these places were very heavily bombed and received many attacks that were driven back from Biggin Hill.

They were only a few minutes' flying time from France and were subjected to sneak attacks by small forces of raiders, as well as heavy ones by fifty or a hundred planes. They were also within range of the big guns that fired across the Channel and many shells fell too close for comfort. In addition, they were within sight and sound of attacks on Channel convoys and of mines exploding at sea. As a permanent nerve-wracker they were under almost every heavy raid that was aimed at London. Practically all crippled fighters made forced landings at one place or the other.

Another item that needs attention is the belief that the defence of these vital airfields was carried out solely by the R.A.F. ground staff. At Hawkinge and Lympne they manned only a few guns. The majority were manned by lads of between 18 and 19½ years of age. They were all volunteers and belonged to A Company, 6th Battalion the Buffs.

The Royal Marines were also active with their Bofors.

These men were the not-so-few who were sandwiched between the Gallant Few and the Stubborn Many.

Wincanton, Somerset. H. V. COSSONS.

Air-display Hooliganism

I HOPE that *some* of the young "aircraft enthusiasts" who visited the display organized by the Elstree Flying Club read this letter. If they do, I hope they are thoroughly ashamed of themselves. I am referring to those youngsters who took part in the stripping of the rear door of an Aerovan of its ply and fabric covering. Surely, if they are true enthusiasts they should do all in their power to keep every aeroplane in an airworthy condition.

This episode seemed to be a repeat performance of the treatment of the Avro Avian at White Waltham on Whit-Monday. In fact, I would not be surprised if some of these vandals have "souvenirs" of both aeroplanes. D. J. SPARROW,

Enfield, Middx. Asst. Sec., Enfield Aviation Club.

[Four boys accused at Maidenhead last week of doing £268 of damage to aircraft at White Waltham were each sent to a detention centre for three months.—Ed.]

First "T" Tails

RECENTLY, there has been some correspondence on the subject of aeroplanes with "T" tails. The H.P.88 was said to be the first aeroplane to have such an appendage, but surely the Meteor 1, EE227/G, which "had no fin or rudder surface above the tailplane," preceded it?

Cheltenham. M. H. HARRIES.

Pterodactyl J8067

WITH reference to recent correspondence in *Flight* concerning the Pterodactyl J8067 which was seen at Farnborough. May I point out that this machine has now found a resting place in the Science Museum, South Kensington, though for some unknown reason, not in the Aeronautical Collection.

London, W.1. JOHN YOUNG.

[A number of other readers have written to this effect.—Ed.]

A.V-M. CARNEGIE'S NEW POST

IT is announced by the British Oxygen Co., Ltd., that A.V-M. D. V. Carnegie C.B., C.B.E., A.F.C., has been appointed to a post in which he will carry out liaison duties with the armed forces and Government departments. A.V-M. Carnegie was with the R.N.A.S. in 1917-1918, and then transferred to the R.A.F. at its inception. Since then he has held a number of important appointments, including those of Director of Flying Training, Air Ministry, 1943-1945; Air Force Advisor to the U.K. High Commissioner in Canada; and Head of U.K. Air Liaison Mission, 1945-1948. Still an active pilot, he was, until his recent retirement, on loan to the New Zealand Government as Chief of Air Staff there. Prior to that he was Senior Air Officer in Scotland, and Air Officer Commanding No. 18 Group, Coastal Command.

A.V-M. Carnegie

A.V-M. Carnegie and Mr. R. J. Foster, D.F.C., A.F.C. (who is already on the staff of British Oxygen) will represent the company in a wide field of aeronautical work. Apart from their already well known activities, the company have developed a system of storing oxygen in aircraft in liquid form at a considerable saving in weight and space over the gaseous system, and are also engaged in research into the uses of liquid oxygen for rocket powerplants.

U.K.-CANADA TRADE DIRECTORY

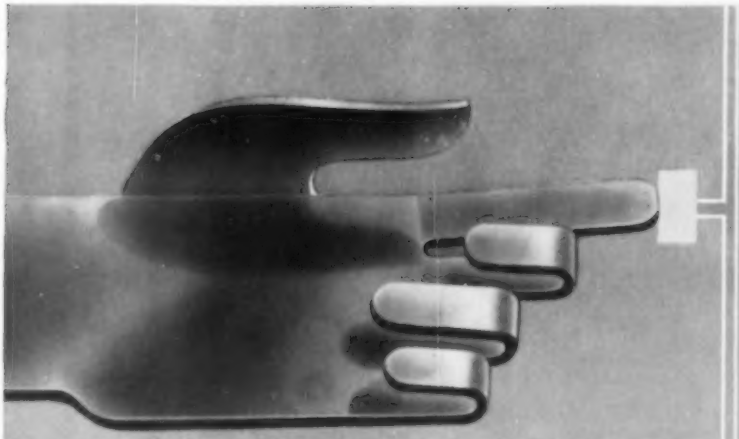
TWO years ago, CABMA—The Canadian Association of British Manufacturers and Agencies, which has as its sole purpose the development of British trade with Canada—collaborated with Kelly's Directories, Ltd., and Iliffe and Sons, Ltd., in the preparation of a directory of British manufacturers and exporters whose products are available in Canada.

The third (1955-56) edition of this directory—the CABMA *Register**—is now available. In its 760 7½in×9½in pages it provides an alphabetical list of some 4,000 different types of British products available on the Canadian market, with their suppliers given under each heading. The French equivalents of these headings are set out in alphabetical order in a separate glossary. A directory of over 4,500 British firms gives details of their distribution arrangements in Canada; and these arrangements involve about 2,750 Canadian companies, about many of whom further information is given in another section. Finally, special sections enable the Canadian buyer to identify products when only their proprietary names or trade marks are known.

*"*CABMA Register, 1955-56, of British Products and Canadian Distributors." Published jointly by Kelly's Directories, Ltd., and Iliffe and Sons, Ltd. (Dorset House, Stamford Street, London, S.E.1). Price, 42s; by post, 44s.*

PYRENE-MINIMAX DEAL

AN offer by the Pyrene Co., Ltd., to purchase the whole share capital of Minimax, Ltd., has been accepted by more than 90 per cent of the latter company's shareholders, and has therefore become unconditional. Minimax—who will continue to operate under the same executives—are an old-established business specializing in fire extinguishers, other fire-fighting equipment, first-aid cabinets and catering equipment.



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CIVIL AVIATION

Pre-service flying hours are now being amassed by four Britannias—one prototype and three production Mk. 100s, the latest of which is seen on a test flight last week. Externally, it may be distinguished by the new flight-deck roof-windows (two per side), though future Britannias will also have this feature. Pilots' view, already excellent in the forward sense, is thus further improved. "Flight" photograph

NEW ZEALAND VISCOUNTS?

ACCORDING to a Wellington newspaper report, New Zealand National Airways Corporation will request Government permission to buy three Viscounts for routes linking Wellington, Christchurch and Auckland. Other sources have said that the airline is also keenly interested in the Handley Page Herald. Last year N.Z.N.A.C. carried nearly 350,000 passengers; their fleet includes 23 DC-3s (including two freighters), four Herons and six Rapides.

U.S. RIGHTS FOR LUFTHANSA

DESPITE objections raised by American airlines to the rights offered to Lufthansa under the proposed bilateral air services agreement between the United States and Germany, the agreement was signed in its original form on July 7th.

Under the terms of the agreement, German aircraft may fly into Boston and Philadelphia in addition to New York, which is already served; to San Francisco or Los Angeles *via* a North Pole route; to Chicago *via* Canada, and to points in South America and the Caribbean *via* New York.

In return, U.S. airlines are granted the right to land in Hamburg and to fly from there to places north and north east. They may also fly to Dusseldorf, Cologne, Bonn, Frankfurt, Stuttgart and Munich and operate services from these cities to points in southern and south-eastern Europe, North Africa, the Near and the Far East.

Lufthansa claim that in 1954 American companies carried 40 per cent of traffic to and from German airports, adding that Germany's airline will not be able to take immediate advantage of the new permits provided in the bilateral. The five L.1049Gs due for delivery in 1956 would be used to extend the network to South America and the Middle East.

SMALL-FIELD PERFORMANCE

IT was reported from France last Friday that Bréguet 763 Deux-Ponts F-BASQ had been successfully flown off an improvised runway near the cornfield at Pont Eveque, Department of Isère, where it forced-landed on May 10th. The aircraft, operated by Air France and carrying 46 passengers and a crew of four (all of whom survived), was damaged in the emergency landing, which at the time was reported to be due to a "defect in rudder control." While on-the-spot repairs were carried out, a runway was prepared in the largest of the adjacent fields. When the aircraft was ready, Maj. Yves Brunaud, Breguet's chief test pilot, "taxied through the stubble to make his dawn take-off."

SIKORSKY'S NEXT CIVIL HELICOPTER

COMPETITION between Sikorsky and Piasecki for the civil helicopter market is hardening. Following Piasecki's recent announcement (*Flight*, July 8th) of Sabena's and New York Airways' interest in their 19-seat PH-42, the Sikorsky division of United Aircraft Corporation state that civil orders are now being accepted for the commercial version of the S-58, and that C.A.A. certification of this 12-passenger machine is expected early next year. Of similar configuration to the familiar S-55, the S-58 is powered by a Wright R-1820 of 1,500 h.p., driving a single main rotor with four all-metal blades, and giving a cruising speed of over 100 m.p.h. It will carry its full payload of 4,000 lb for distances of "up to and over 100 nautical miles."

THE VALUE OF HARNESS

A REMINDER of the value of pilots' shoulder-harnesses is contained in a summary of the official report on the T.A.A. Viscount training accident at Mangalore, Victoria, on October 31st last year. The aircraft struck the ground in a steep turn to starboard after taking-off on three engines at a speed well below that stipulated in the flight manual.

Two pilots and a supernumerary pilot were killed and the five other occupants (who were in the main cabin) survived, reporting "only moderate deceleration on impact." The report notes that: "Both pilots, who were wearing lap strap type safety belts, but not the shoulder harnesses available to them, received fatal head injuries from contact with cockpit fittings. One pilot had no injuries below his head and the other, apart from head injuries, had a broken thigh. After an examination of all the circumstances it is concluded that had the pilots been wearing the shoulder harnesses available to them they may have survived the accident."

A supernumerary pilot who survived the accident, having moved back from flight deck to cabin before the impact, gave evidence that the unstick speed was 85-90 kt. This compared with a minimum control speed (20 deg flap, No. 4 engine feathered) of 96 kt, and a T.A.A. flight-manual figure of 106 kt; in practice, the airline had stipulated a minimum unstick speed of 110 kt for three-engined take-offs.

Take-offs on three engines are not, of course, a part of normal scheduled operations. It is, however, a frequent airline procedure to ferry empty aircraft to a maintenance base with one engine inoperative rather than transport a replacement engine to the aircraft. Consequently, crews may require training in three-engined take-offs, though, in its report on the accident mentioned, the Australian Department of Civil Aviation pointed out that such training was not one of the Department's conditions for four-engined-type endorsements to pilot's licence.

AUSTRALIAN'S D.C.A.'s RETIREMENT

DUE to retire early in August, Air Marshal Sir Richard Williams has been requested to remain in office as Australia's Director-General of Civil Aviation until the end of this year. Sir Richard, who was born in South Australia 65 years ago, learned to fly in 1914 and six months later took command of No. 1 Sqn., Australian Flying Corps—the Commonwealth's first complete combat squadron. From 1932-46, when he transferred to the retired list, Sir Richard served as Chief of the Air Staff, R.A.A.F. He took up his present appointment in 1947 and was knighted in 1954.

Sir Richard will be succeeded by the Deputy Director-General, Mr. Donald Anderson, 38, who served as a transport pilot with the R.A.A.F. during the war. Since joining the Department of Civil Aviation as an examiner of airmen in 1946, Mr. Anderson has built up an excellent reputation as an organizer and administrator.

HYDRANT REFUELLING AT SHANNON

THE largest hydrant refuelling system in Europe was put into operation at Shannon Airport at the end of June. The system virtually dispenses with the need of refuelling tankers; in place of the tanker, one small mobile unit connects the 8in hose from one of the recessed hydrant points set in the tarmac with the fuel tanks of the aircraft. This dispenser both measures and filters as it delivers fuel at the rate of over 150 gal/min through each of a pair of delivery hoses.

Refuelling at Shannon is now only a matter of a few minutes, though time-saving is not the only advantage of the new system. A high proportion of landings at Shannon—8,208 were recorded in 1954—are non-scheduled refuelling stops; consequently, the ability to provide quick service at peak periods is bound to entail under-utilization of tankers and their crews at other times.

The Shannon system was installed by the Esso Petroleum Co.

"Flight" photographs

Scenes at the opening of the hydrant system at Shannon: (left) a mobile dispenser and (right) one of the recessed hydrant points.

CIVIL AVIATION . . .

(Ireland), Ltd., at a cost of £80,000. The main low-pressure pumping unit is situated approximately a mile from the tarmac and adjacent to the main bulk storage tanks. At about mid-distance, on the perimeter of the airport, is the satellite or intermediate storage unit—consisting of six 12,000 gal fuel tanks; high-pressure rotary pumps; automatic, electrically operated flow and pressure valves; and remote control for emergency cut-off, which can be operated from the tarmac. In addition, there is an electronically controlled water detector, complete with automatic valve operation.

Fuel is fed from this unit in 8in underground lines to 30 hydrant points under man-hole covers situated in groups of three around the tarmac adjacent to the airport buildings. In all, over 3½ miles of underground pipes were laid down.

Constant pressure is maintained on the fuel in the lines. When a hydrant is connected, via the mobile dispensing unit, with an aircraft and pumping begins, the momentary pressure-drop brings into action the rotary pumps, which immediately restore the working pressure. Should additional points be subsequently brought into operation, an ingenious automatic flow-control ensures that the maximum output is maintained: in fact, the maximum take-off for each of the two grades of fuel available is 900 gal/min.

The official opening of the new system was achieved with a refreshing absence of pompous ceremony, which is so often apt to mar such occasions, by Mr. William Norton, T.D., Eire's Minister for Industry and Commerce. Later, at a reception and dinner given to mark the occasion, he thanked his host, Mr. T. F. Laurie, chairman and managing director of Esso Petroleum Co. (Ireland), Ltd., for the enterprise of his company in installing the hydrant system. In spite of the "threat" of aircraft with even greater operational ranges than at present, said Mr. Norton, such confidence in the future of the airport convinced him that it would be many years before Shannon would be overflown.

CLUB AND GLIDING NEWS

"WE are trying to cater for the private pilot who has neither the time nor the money to indulge in air racing but who, despite limited experience, would like to have a crack at a competition." So writes Capt. Ron Gillman, chairman of the Vintage Aeroplane Club, in a letter giving details of the rally to be held by that enterprising band of enthusiasts on Sunday, July 24th, at Denham.

Entry conditions are not stringent, and it is thus hoped to attract pilots without previous experience of competitive flying. Entrants must have at least 50hr in their logbooks, but this total can include dual time; no F.A.I. competitor's licences are required; entry fee will be one guinea. There are two classes of entry—"private" and "club," both of which are open to civil types not exceeding 12,000 lb fully loaded.

The contest is simple in form, consisting essentially of a straightforward navigational exercise. In the award of points, emphasis will be on time-keeping and airmanship. The course, of approximately 150 miles, will begin and end at Denham, and there will be an intermediate landing at Portsmouth. Aircraft will also be required to report over certain turning-points en route. At briefing, pilots will be given the average ground speed which they will be expected to achieve, together with details of routing and timing. No aircraft will be permitted to carry more than two people, pilot included, and radio aids to navigation are barred.

Three trophies, all put up by the Vintage Aeroplane Club, will be awarded to the most successful pilots. The highest-placed private entrant will receive the Chiltern Hills Trophy, and the Harmel Trophy will go to the winning club entrant; the West London Trophy will be awarded to the highest-placed vintage aircraft.

The rally is being staged as part of the V.A.C. garden party to be held at Denham on July 24th. While rally aircraft are absent there will be a flying programme, which will include demonstrations by Ranald Porteous and "Tim" Wood. The garden party will be open to members only; details of half-yearly membership (10s 6d, entitling the holder to two garden-party tickets) may be obtained from the club secretary, Miss J. Barker, Stanway, Denham Green Close, Denham, Bucks.

FROM Southampton Airport, base of the Hampshire Aeroplane Club, V. H. Bellamy reports that four members converted to the club's newly acquired dual Proctor V on its first weekend there. This club was well represented at the Rally des Vins et Chateaux at Anjou, 15 members attending in three aircraft—Rapide, Proctor and Hornet Moth. Switzerland, Spain and North Africa are next on the itinerary. Among several newcomers to H.A.C. was a pilot who began renewing his licence one morning on the Hornet Moth and so liked it that by the evening he had become the proud private owner of a similar aircraft.

MEMBERSHIP of the Plymouth Aero Club now averages 300, the aircraft fleet comprising three Tiger Moths, a Messenger, a Gemini and two Austers. For the fourth consecutive year, the club is providing recreational flying for the senior Cadets at the Royal Naval College at Dartmouth, and is also training its quota of A.T.C. and R.A.F./C.C.F. Cadets. A notable improvement in the ability of the latter is discernible, the secretary reports, since the Air Ministry decision that only those Cadets who have passed the Aircrew Selection Board should be awarded Flying Scholarships.

On the social side, the club's activities continue to grow, under the chairmanship of Sir Arthur Hollely, who has been actively connected with the club since its formation over 25 years ago. An innovation has been the display, in the clubhouse, of oak panels bearing the names of those who have made their first solo flights in club aircraft since flying re-started after the war (in April 1947). Between then and the end of April, 1955, 109 first solos have taken place, and fresh names are being added regularly. The panels were unveiled by the chairman on June 9th, in the presence of a large number of members and their guests.

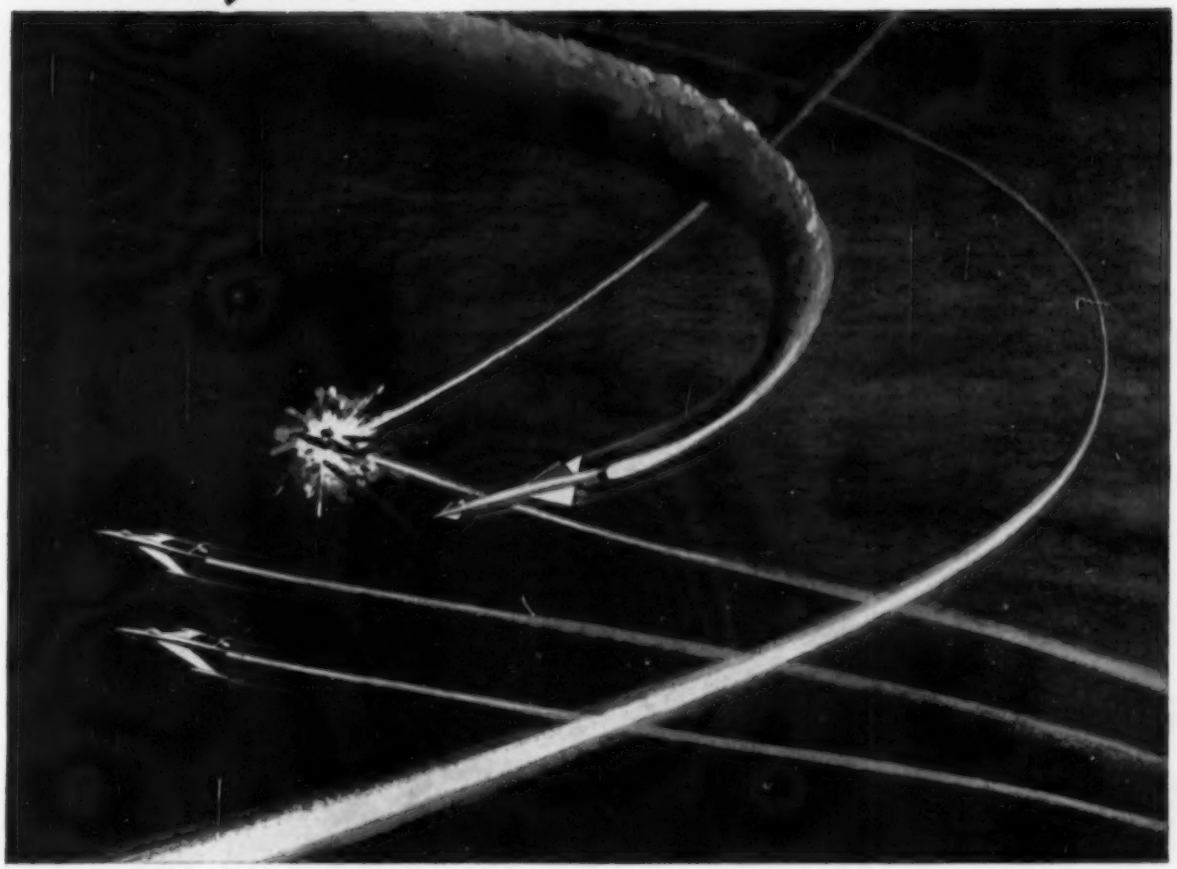
NEW chief flying instructor of the Ulster Flying Club is Cyril Dash, A.F.C., who succeeds A. F. Burridge. Mr. Dash has completed 9,500 hours' flying with Short Bros. and Harland, who manage the club, since he joined the company in 1942 as an instructor at 24 E.F.T.S., Luton. An unusual episode in his career was training a pupil to first-solo stage by night flying only.

THREE members of the Strathtay Aero Club—Miss Burnett and Messrs. A. McLennan and L. T. Brown—qualified for P.P.L.S. in June, and the club has a further 12 members under active instruction. Strathtay's Messenger has recently been undergoing its 450 hr check, and the inspection was prolonged by delay in obtaining spares, but despite this reduction in fleet strength the club succeeded in increasing June flying hours, compared with the June 1954 total.

MAY at Yeadon opened rather badly as regards weather, high winds restricting flying during the first fortnight to 40 hours. The second half of the month saw an improvement, and the final figure for the four weeks was 158 hours. Mr. P. B. Stephens was the only first soloist, whilst Mr. J. M. S. Procter and Cadet P. G. Bamforth obtained their P.P.L.s.

DECISIONS made at the recent meeting of the F.A.I. Gliding Commission included the deletion of one class of gliding record and the addition of two new classes in the list of those recognized by the F.A.I. No new records for duration will now be accepted, and none will be listed after December 31st, 1960. The new categories are both for speed over a triangular course, of 200 km and 300 km respectively. These three proposals were put forward at the meeting by the German Aero Club; Philip Wills on behalf of the B.G.A.; and the Aero Club of Poland respectively, and were subsequently adopted.

Today and Tomorrow...



CANADAIR COUNTS — *in Guided Missiles*

Grim herald of the push-button war, the guided missile's development has become an urgent matter for all world powers. The missile itself is not enough . . . the race is now for sharper control, greater speed, higher altitudes, more sensitive response.

In the interests of national security, this program is naturally classified but we can say this much: we are working closely with Canadian government research agencies, in the advanced technological fields of design, development and construction of guided missiles. We have produced missile airframes and control equipment . . . have seen them through actual firing tests.

This is a challenging field, where Canadair engineers face and overcome new problems every day. In missile development, as in other fields of aeronautical achievement, people who know say, "you can count on Canadair."

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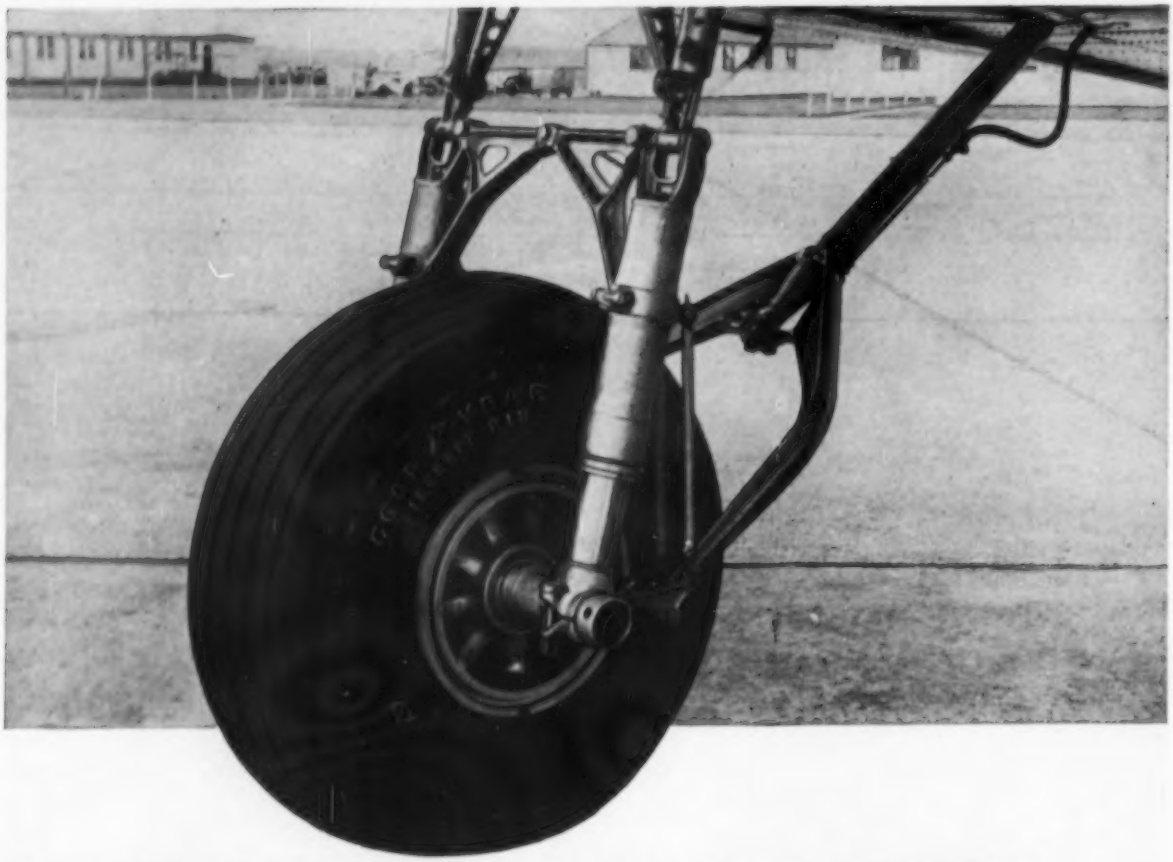

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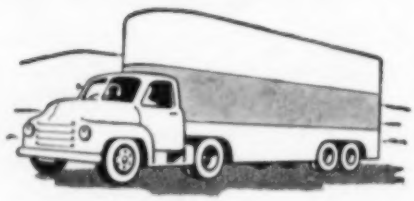

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"Flight" photographs

The Prime Minister at West Malling. (Left) Sir Anthony Eden inspecting the pilots and ground crews. (Right) Presenting the Cooper Trophy to S/L. Clause.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

No. 500 Squadron Presentation

AS the unit's Honorary Air Commodore, the Prime Minister, Sir Anthony Eden, attended West Malling last Saturday to present to No. 500 (County of Kent) Squadron, R.Aux.A.F., the Cooper Trophy. He flew down from Bovingdon in a Devon and was greeted on arrival by the Station Commander, G/C. P. H. Hanley.

After inspecting the parade Sir Anthony gave a brief address in which he thanked all members for the time and effort they devoted to making the unit efficient and recalled the high spots in the squadron's history. He then presented the trophy, which was received on behalf of the squadron by the commanding officer, S/L. D. M. Clause, A.F.C.

Following a tea interval the squadron Meteors took off and flew over the saluting base in arrowhead formation. F/O. R. W. Napier gave an excellent display of individual aerobatics. On the return of the Meteors to the airfield the Prime Minister inspected the pilots and ground crews, shaking hands with each man.

No. 810 Squadron Commissioned

UNDER the command of Lt. Cdr. P. M. Lamb, D.S.C., A.F.C., R.N., No. 810 Squadron, R.N., commissioned at Lossiemouth on July 4th. The unit is equipped with Sea Hawk FGA.4 aircraft.

No. 810 was originally formed in 1933 in H.M.S. *Courageous* by combining Nos. 463 and 464 Flights. The first squadron equipment was the Blackburn Dart torpedo-bomber.

Sir James Barnes' Retirement

ON the occasion of his retirement as Permanent Under-Secretary of State for Air, Lord De L'Isle and Dudley and members of the Air Council gave a private dinner in honour of Sir James H. Barnes. He is succeeded by Sir Maurice Dean, K.C.M.G., C.B.

R.C.N. Appointment

SUCCEEDING Cdre. W. L. M. Brown, D.S.O., O.B.E., D.S.C., R.N., who has completed two years in Canada, Cdre. H. P. Sears, R.N., has been appointed Assistant Chief of Naval Staff (Air) and a member of the Naval Board of the Royal Canadian Navy. On his return to England, Cdre. Brown is to become Director of the Senior Officers' War Course at Greenwich.

Cdre. Sears made his first deck landing in July 1928 and his last in an Avenger in July 1954, when he became the first Naval pilot to land on an angled deck.

H.M.S. "Condor" Air Day

SCOTLAND'S 1955 Naval Air Day and At Home was held on the afternoon of Saturday, July 2nd, at H.M.S. *Condor*, Royal Naval Air Station, Arbroath. As most of the technical training in connection with maintenance of Naval aircraft of the Fleet Air Arm is done in H.M.S. *Condor*, large and varied displays of aero-engines, airframes, air armament and equipment were on view in the various hangars.

The flying display was held in two parts and was opened by a display of formation flying and aerobatics by Sea Hawks from Lossiemouth. During the course of the afternoon aircraft of the Scottish Air Division of the R.N.V.R. demonstrated formation flying, stream landing and carrier take-off, and carried out an aerial attack on the control tower.

Gannet, Vampire, Skyraider, Sea Fury, R.A.F. Shackleton and Neptune aircraft were all demonstrated, and additional items were aerobatics by an Olympia glider and a winch take-off by a Slingsby two-seater glider from H.M.S. *Condor's* gliding club. The second part of the flying programme included a helicopter rescue demonstration by an S.51 Dragonfly, and fast runs and aerobatics by an R.A.F. Hunter.

An attendance of 8,000 ensured a handsome sum for Naval charities.

P.A.M.C. Rally

THE Per Ardua Motor Club's Hendon Rally is fixed for Sunday, July 24th. Entry forms are now available. S/L. W. A. James has now taken over the duties of honorary secretary to the club and all correspondence should be addressed to him at 111, Briar Avenue, Norbury, London, S.W.16.

Fire-fighting Competition

AT Kenley on Friday last the Royal Air Force held its annual Inter-Command Fire Fighting Competition.

The events took place before a number of guests for whom it was unfortunate that the wind had gone into the north-east quarter. In the Light Trailer Pump Drill some of them received a generous spray of water and in the Rescue from Smoke Filled Building many had to move to avoid being choked.

Perhaps one of the most interesting events of the afternoon was the simulated rescue of a pilot from an aircraft which had crashed in an inaccessible position. This rescue was made with the aid of a Bristol Sycamore—the fireman jumping from the helicopter as it approached the ground. The fire having been doused the pilot was winched up to the Sycamore, followed by his rescuer.

In the Aircraft Crash Rescue Drill event

Fire-fighting at Kenley. (Left) Rescue from an "inaccessible" crash. (Centre) Demonstrating the new compressed air panel cutter. (Right) Sir Harold T. Lydford presents the trophies.

"Flight" photographs

SERVICE AVIATION . . .

the new compressed-air-operated panel cutter, designed by the Ministry of Supply, was demonstrated.

The winners of the various events were: *Light Trailer Pump Drill*, Maintenance Command. *Large Trailer Pump Drill*, Flying Training Command. *Aircraft-Crash Rescue Drill*, Technical Training Command. *Rescue from Smoke Filled Building*, Technical Training Command. *Crashed Aircraft Fire-fighting Competition*, Fighter Command. *Hose Reel Drill*, Maintenance Command. The premier award, the R.A.F. Fire Service Proficiency Shield was won by Fighter Command with Bomber Command as runners-up.

In *The Inter-Service Competition* the Royal Naval Air Command was beaten by the R.A.F. and in the *Allied Air Forces Competition* the Royal Canadian Air Force beat both the U.S.A.F. and the R.A.F.

The trophies were presented by Air Marshal Sir Harold T. Lydford, A.O.C.-in-C. Home Command.

Lee-on-Solent Air Day

HEADQUARTERS of the Fleet Air Arm, H.M.S. *Dædalus* (R.N.A.S. Lee-on-Solent) always aims to put on something rather distinctive in the way of an annual Air Day, and last Saturday's event was in this tradition. As usual, H.M.S. *Siskin* (R.N.A.S. Gosport) collaborated—but for the last time, because this historic airfield, which was one of the original five used by the R.F.C. before World War I, is about to be closed down and built upon.

The principle on which this year's Air Day was organized was the excellent one of having a first-rate static show, of both aircraft and equipment, open for five or six hours, plus a highly concentrated flying display, lasting less than three-quarters of an hour, as a *pièce de résistance*. In the following brief notes on the display, the programme timings (which were adhered to within seconds) are quoted in order to show what can be achieved by highly efficient stage-management and a perfectly disciplined "cast."

Flying began at 1500 hr with a fly-past by a dozen assorted helicopters (Whirlwinds, Dragonflies and Hillers) of No. 705 Squadron (Lt-Cdr. J. C. Jacob), Gosport, followed by Sea Hawks of No. 800 Squadron, Brawdy, and Sea Vampires of No. 764 Squadron (Lt-Cdr. D. F. Battison), Ford. This was followed at 1502 by formation aerobatics by the Sea Hawk team, led by Lt-Cdr. D. P. W. Kelly, of No. 806 Squadron, which has recently disembarked from H.M.S *Centaur*. Their show—executed in bumpy conditions—can only be described as superb, and the thought occurred that an inter-Service aerobatic competition with, say, the No. 43 Squadron Hunter team would prove instructive.

At 1509 Lt. "Dick" Turpin from Gosport gave a lively low-altitude display with a Hiller H.T.2, to be followed at 1515 by a one-at-a-time fly-past of six Naval aircraft, varying in period and performance between the sole remaining Swordfish (flown, complete with torpedo, by its usual exponent, Lt-Cdr. M. W. Rudorf) and a Fairey Gannet.

At 1521 a "mermaid" was picked up—"rescued" somehow seems an inappropriate term—in a Dragonfly's scoop net, and at 1525 the D.H.110 was the subject of a demonstration by D.H. assistant chief test pilot John Wilson—somewhat restricted by a temporary, non-retractable experimental air brake under the nose of the aircraft; then, strangely contrasting in size and shape, the Folland Midge was very prettily demonstrated (at 1528) by Folland chief test pilot E. A. Tennant.

A stiff breeze meant an uncomfortable touch-down for Maj. J. L. A. Painter, Special Air Service, who at 1531 made a parachute drop from a Whirlwind helicopter. At 1533, Lt-Cdr. R. Brett-Knowles, who is C.F.I. at Portsmouth Naval Gliding Club, gave a sailplane aerobatic demonstration in an Olympia.

And so to the final item—just 37 minutes after the opening turn—an aerobatic demonstration by Lt-Cdr. Kelly in his Sea Hawk. It would be invidious to say that this solo item was even more perfect than his team's demonstration, but it was certainly a joy to watch. With every manœuvre precisely positioned, in spite of a clear blue sky that offered no cloud as a reference-point, Kelly began with three upward rolls, repeated vertically downwards, then went through a routine that included beautifully executed Derry turns, low inverted passes and—two most curious effects—(a) a very slow vertical climb with a stall turn off the top and (b) a slow loop.

Altogether, a programme which permitted not a second's boredom for either layman or expert.

R.A.A.F. Decompression Test

AT Point Cook recently, F/L. E. Shaw of the Australian Aircraft Research and Development Unit underwent an explosive decompression test supervised by S/L. P. A. O'Brien of the medical branch.

The test was made in a decompression chamber and conditions simulated a sudden change from pressures equal to those at 38,000ft to those obtaining at 55,000ft. F/L. Shaw, wearing the suit shown in the photograph below, suffered no ill effects from the experience.

Half-yearly Promotions

BELOW is continued from page 65 the half-yearly list of promotions.

Squadron Leader to Wing Commander: H. A. Chater, A.F.C.; W. A. Nel, D.S.O., D.F.C.; P. R. Godby; K. H. P. Murphy, M.B.E.; D. S. Hoare; R. C. Patrick, D.F.C., A.F.C.; N. A. Sellars; S. R. Thomas, D.F.C., A.F.C.; A. M. Gill, D.F.C.; F. J. Higham, O.B.E., D.F.C.; G. H. S. Smith; A. F. Fegen; J. A. Sowrey, D.F.C., A.F.C.; T. R. N. Wheatley-Smith; I. H. Cosby, D.F.C.; F. G. Daw, D.F.C., A.F.C.; C. K. Gray, D.F.C.; T. Stevenson, A.F.C.; K. W. J. Tarrant, D.F.C.; C. F. Babbage, D.F.M.; R. A. Jell, D.F.C.; F. Rothwell, D.F.C.; A. V. Plowright; G. Young; H. B. Hunt, D.S.O., D.F.C., A.F.C.; J. Quinn, D.F.C.; S. T. Underwood; J. E. S. Hill, D.S.O.; D. H. Sutton; A. H. Gibb; F. W. M. Jenson, O.B.E., D.F.C., A.F.C.; R. L. W. Baelz, D.F.C.; J. C. T. Downey, D.F.C., A.F.C.; J. Hurry, D.S.O., D.F.C.; J. L. W. Ellacombe, D.F.C.; R. K. Orrock, D.F.C.; P. W. Jamieson, A.F.C.; B. P. T. Horsley, A.F.C.; R. N. G. Allen, D.F.C.; A. C. Blythe, D.F.C.; G. A. Elliot, D.F.C.; J. Seldon.

N. A. Gwyther, O.B.E.; G. W. Price; A. G. Sollis, A.F.R.Ae.S.; W. Edwards; F. J. Fenner; A. S. Harman, O.B.E.; J. L. Whitford; A. S. Mohan; H. A. Pritchard; E. T. McCabe, O.B.E.; G. L. Cochrane; C. V. G. Usher, A.F.R.Ae.S.; A. J. J. Kirk; R. G. K. Smith; L. H. Moulton, D.F.C.; A. S. Knowles, A.F.C., A.F.R.Ae.S.; R. J. Lewis, B.Sc.; A. H. Porter, O.B.E.; J. W. McKelvey, M.B.E.; A. J. Peart; K. J. Powell, B.Sc., A.F.R.Ae.S.; P. C. Cleaver, O.B.E., A.M.I.Mech.E., A.F.R.Ae.S., D.C.Ae.; P. L. Crowell, A.F.R.Ae.S.; K. B. S. Willder, B.Sc., A.M.I.E.E.; P. Cartridge; W. J. Nightingale; R. J. Tilley; E. A. Bradly; J. P. Beale; A. P. B. De Mornay; B. C. A. Fox; J. Eames, D.F.C., A.A.C.C.A.; W. C. Armstrong; J. W. Grey; A. J. Sansom; B. Morgan, M.B.E.; W. F. Hook; C. H. Wiggins; N. E. Hext, M.B.E.; D. F. H. Bird, D.F.C.; J. R. Pullan, A.C.A.; A. H. Wilkes, O.B.E.; J. Sanderson, A.S.A.A.; P. M. Gosse, M.C., R.A.F. Regt.; J. K. F. Mason, M.B., Ch.B., D.C.P.; J. M. Ferguson, M.R.C.S., L.R.C.P.; W. O. Davies, M.R.C.S., L.R.C.P.; P. O. Wilson, L.D.S.; W. C. Vaughan, M.B.E., B.Sc., Ph.D., A.M.I.E.E.; F. Bartle, B.Sc.; A. T. Mathews, B.Sc., A.F.R.Ae.S.; E. J. Brice, D.Phys.Ed.; J. A. Smith; E. W. T. Hardie. *Squadron Officer to Wing Officer:* D. B. von Donop, W.R.A.F.

(To be continued)

"Fighter" Wins Methuen Cup

AT Bisley on July 1st 32 teams shot for the Methuen Cup, which was won by R.A.F. Fighter Command with a score of 1,348 points. Runners-up were Plymouth Group Royal Marines with 1,344.

Laarbruch Airfield

BUILT in one year 14 days, Laarbruch, the new 2nd A.T.A.F. airfield in North Germany, accommodates several thousand Service people. During "Carte Blanche" Laarbruch's resident R.A.F. Canberra and Meteor squadrons moved to other locations and were replaced by additional units of the Royal Netherlands Air Force and a squadron of the Royal Norwegian Air Force.

Construction of Laarbruch started on October 1st, 1953, when a small party from No. 5357 Airfield Construction Wing, R.A.F., moved in to supervise clearance of the site. The initial task was to remove 40,000 trees to provide space for the runways, taxi tracks, roads and buildings. The R.A.F. men were joined by Dutch and German experts and in a few weeks the

F/L. E. Shaw, R.A.A.F., who acted as "guinea pig" in decompression tests recently made in Australia, with his medical officer, S/L. P. A. O'Brien. (See "R.A.A.F. Decompression Test," this page.)

labour force grew to 5,000. Eleven months after the work had started advance parties from the R.A.F. and Royal Netherlands Air Force flying units began to install stores and equipment, administrative offices and transport parks, and about six weeks later the station opened for operational flying.

Because of its isolation Laarbruch is completely self-contained, providing its own services and amenities. It boasts the most efficient power house of any NATO station, not only generating all the electricity, but heating all the water for the camp by the turbine gases. There are 400 families' quarters, and one of the largest schools ever built on a R.A.F. station meets the needs of the 600 children. A large central store operated by N.A.A.F.I. is supplemented by mobile shops operated by German traders from nearby villages. There is a 300-seat cinema and a comprehensive education block housing an art studio, carpentry shop, photographic darkroom, modelling workshop and study rooms. There are seven soccer pitches, four cricket pitches, rugby and hockey pitches and a running track. A swimming pool is under construction.

Dutch and British mess together and are represented on all station committees organizing recreational and educational pursuits. President of these committees is the Station Commander, G/C. G. W. Petre, D.F.C., A.F.C. In addition to his operational responsibilities he has to play the part of "mayor" to the international township, and a "corporation" including German representatives has been formed to assist with community relations.

Reunion

THE reunion dinner of No. 115 Squadron Association will take place at 1900 hr on October 22nd at Gilmour Caterers, 307 High Holborn, London, W.C. Tickets (14s 6d) and particulars from Mr. P. Williams, 71 Paulet Road, London, S.E.5.

THE "ARIES" FLIGHTS

FURTHER details are now available concerning the recent Ottawa-London and trans-polar flights of the R.A.F. Flying College Canberra *Aries IV*.

The Royal Aero Club has announced that, subject to official confirmation, the aircraft, piloted by S/L. I. G. Broom, D.S.O., D.F.C., flew from Ottawa to London, a distance of 3,330.41 miles, at a speed of 496.8 m.p.h., in a time of 6 hours 42 minutes 12 seconds. The R.A.F. therefore claim to have set up a record for the Atlantic flight, for this is the first "capital-to-capital" jet crossing.

Aries was met on the tarmac by the Commandant of the R.A.F. Flying College, A. Cdre. G. A. Walker, C.B.E., D.S.O., D.F.C., who was the first to speak to the pilot after the aircraft had made radio contact with the control tower at 0300 hr (BST), forty-eight minutes before it landed.

Also waiting to greet the crew were A.V-M. G. E. Nicholetts, C.B.E., A.F.C., Senior Air Staff Officer, Flying Training Command, and G/C. P. H. Hamley, A.F.C., the Commanding Officer of R.A.F. West Malling, and members of the R.A.F. Flying College, who flew down earlier from Manby.

(A.V-M. Nicholetts, as a flight lieutenant, himself helped set up a long-distance record, as co-pilot of the Fairey-Napier monoplane which flew from Cranwell to Walvis Bay, South Africa, a distance of 5,341 miles, in 52 hours 25 minutes in 1933.)

Up to less than ten minutes before the landing, ground fog which had suddenly blown in over the airfield threatened not only to make the landing process critical but even to interfere with the timing of the flight by R.Ae.C. officials. There was considerable tenseness in the control tower, for it soon appeared that not only the record attempt but the very safety of the crew might be in jeopardy since, due to a fuel feed trouble, the aircraft had fuel for only a few minutes should the landing not be possible at the estimated time of arrival at West Malling (3.40 a.m.).

At 0300, when first radio contact was made, the runway was still fairly clear. By 0327 visibility was down to 100 yards. at 0334, however, the fog was fluctuating, and the pilot was warned to be prepared to overshoot if necessary and land at Biggin Hill, 14 miles west. Following a thinning of the fog, the final decision was made, to "feed the aircraft in" as quickly as possible by G.C.A. to West Malling. A minute later the machine was overhead, but S/L. Broom reported "negative" when asked if the airfield lights could be seen. However, the Canberra was then turned on to the approach for the let down, and made a perfect landing in the mist. The touch down time was at 0347 hr plus 43 seconds.

A. Cdre. Walker's comments were: "A remarkable feat—the final stages of the flight demanded the highest standard of knowledge of the aircraft's capabilities, and crew and team work of the highest order. It was a fine feat of pilotage to land in these conditions, for the aircraft was being flown to very fine limits, and its a wonderful tribute to the aeroplane and its engines. This actual Canberra—No. 699—has now broken the record to and from the Cape, flown to the North Pole and back from Norway, made the first trans-polar flight by a jet aircraft (on the outward flight, over the North Pole to Alaska from Norway) and has now added this first capital-to-capital trans-Atlantic jet flight to its achievements."

On stepping out of the aircraft, S/L. Broom said though they would have liked a little more fuel in hand, some unfortunately getting trapped in the tanks, thus making the margin a little tighter than expected, it was on the whole an uneventful flight.

"We came over above the weather and were at 49,000ft over the Irish coast and 50,000ft when approaching London, and had a tailwind of 15 to 20 kt. As we were flying eastwards, into the sun, we were in darkness for only 2½ hours. There was not a ripple in the air the whole way."

On landing the crew were presented with a basket of strawberries labelled "With the compliments of the North Pole"—the "North Pole" being a nearby inn, and the message being an allusion to the trans-polar flight made by *Aries*.

S/L. Bower and S/L. Seymour, the navigators, had also flown in *Aries* on the trans-polar flight last week, when it was piloted by W/C. M. D. Lyne, A.F.C.

S/L. Bower said they were greeted by their own Hastings aircraft—flown ahead to Alaska to back up the flight—100 miles off the coast of Alaska, and by U.S.A.F. fighters on approaching the landing ground at Ladd after the Polar flight.

"The flight over the Pole was clear all the way—we never saw so much of the Polar ice before. The problem of flying over the Pole instead of up to it and back again was easier, for this avoided the 180 deg turn otherwise necessary and the consequent upsetting of the gyros—the accuracy of which has to replace the ordinary compass in those regions.

"The weather was good—and that at Fairbanks extremely good, for the temperature there was 75 degrees (warmer than here!)."

The Commandant's final observation on the whole exercise was that, magnificent though this Atlantic crossing was, the real achievement of the exercise from a navigation point of view was the trans-Polar flight—an outstanding feat and the first trans-Polar flight by any jet aircraft.

S/L. Broom added a tail-piece to the effect that, having crossed the Atlantic at extreme range with no trouble at all, and having the utmost confidence both in his navigators' ability to get him to West Malling exactly when and where estimated, and in the renowned reliability of the airfield's G.C.A. operators to get the aircraft down safely, the worst part of the flight was the last 100 yards—on the ground. Then, while moving a little more than a walking pace, he was unsure where he was—having lost his position when trying to navigate round the perimeter of the track in the dense mist.

West Malling at 0400 hr (left to right): G/C P. H. Hamley, A.V-M. G. E. Nicholetts, S/L. R. A. Seymour, S/L. D. Bower, S/L. I. G. Broom (apparently suffering from a little compression trouble), and A. Cdre. G. A. Walker.

BRITISH ENGINE for ULTRA-LIGHTS

ONE of the principal factors delaying the building of ultra-light aircraft in England has been the lack of suitable engines in the 30 h.p.-60 h.p. range. Foreign units of this power, built specifically for aircraft, have been extremely expensive, particularly as imports; and such adaptations as the Volkswagen, which is used extensively in France, are not cleared for use in England.

The Popular Flying Association has made intensive efforts over the past few years to interest engine companies in the production of a suitable power unit, but in each case it was found that the cost of tooling up was inordinately high and that no company would undertake development unless there was a reasonable certainty of an order for about 1,000 engines. The Association therefore decided that the solution lay in the adaptation of an industrial engine of proven reliability, and it was able to interest Major W. A. Weaver, managing director of Coventry Victor Motor Co., Ltd., in the project. Major Weaver undertook to convert the flat-four Coventry Victor Neptune for aircraft use at his own expense.

Similar in layout to the American Continental and Lycoming types, the Neptune is simple and robust. It is in quantity production for many industrial purposes and used by both the Admiralty and R.A.F. The conversion for aircraft installation consisted of the fitting of special overhead-valve cylinder heads and of casting the main structural units in light alloy, using the same moulds as before. Steel liners were fitted in the cylinders and a thrust race and airscrew shaft added.

The resulting engine, called the Flying Neptune, develops 55 b.h.p. at 3,200 r.p.m. for a dry weight of 220 lb. Total capacity is 1,816 c.c., and continuous cruising power 44 b.h.p. at 2,600 r.p.m. Lubrication is from a wet sump holding seven pints of oil, with pressure feed to all bearings. Ignition at the moment is by a single B.T.H. or Lucas magneto, but it is intended in the future to fit a double magneto to provide dual ignition. The carburettor is by Solex, with a Coventry Victor induction system.

The B.K.S., Ltd., Cub in which the Coventry Victor Flying Neptune was installed for flight trials.

Flight recently had the opportunity of flying the Piper Cub belonging to B.K.S. Engineering, Ltd., in which the prototype engine had been installed by them for flight tests. At the time the unit had already completed 46 hours without trouble and after 50 hours it was due to be stripped down for A.R.B. inspection.

Further lightening is contemplated as the engine is still a little heavy and, quite understandably, not over-powerful for a Piper Cub; but in the air it performs excellently. There is hardly any vibration and the throttle response is remarkably accurate and smooth. All temperatures remain suitably low (oil, 40-50 deg C; cylinder heads, 100 deg C) despite prolonged running at climbing power. The Neptune is also a very clean engine and consumes hardly any oil.

With the present Jicwood wooden airscrew, maximum r.p.m. are 2,800. Maximum power will later rise to 60 h.p.

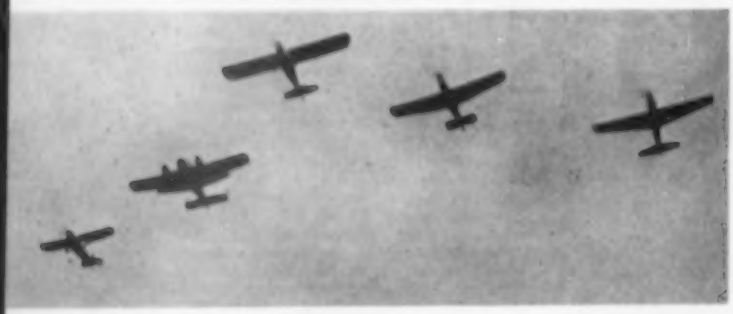
LIGHT ENTERTAINMENT AT ELSTREE

FOR their flying display at Elstree Airfield on July 2nd the Elstree Flying Club had prepared a comprehensive programme which was to have included aircraft of all types from vintage lights to the latest swept-wing jets. In the event a very pleasant afternoon's entertainment was provided despite last-minute orders from Air Ministry to cancel all but two of the Service events. On the morning of the display a further order was issued forbidding all aerobatics by Service jet aircraft. The task of David Ogilvy, the organizer, would have been considerably eased had the Air Ministry rulings been made known a good deal earlier.

However, the afternoon got away to an excellent start with a formation fly-past of a Gemini, an Avro Tutor, a Chipmunk, an Auster, a Magister and a Comper Swift. This was immediately followed by a typically dashing and precise aerobatic display by David Ogilvy in the Comper Swift and similar displays were given in turn by a Magister, Tutor and Chipmunk. A height-and-speed-judging competition with two Austers had as a prize a free ride in one of the Rapides, which did a good trade in joy-rides throughout the afternoon.

The quietest event of the display was an excellent performance of sailplane aerobatics by a Meise, which finished with a well-judged landing right in front of the public enclosure. By contrast the conclusion of the afternoon's programme was marked by the impressively noisy fly-past of four Meteors of No. 600 (City of London) Sqn, R.Aux.A.F. These, however, departed all too soon because of the Air Ministry's veto on aerobatics.

Elstree's composite formation included the Comper Swift, Gemini, Auster, Magister and Chipmunk. The Avro Tutor had not yet joined up.



(Left) The Jodel Bébés from Beauvais are wheeled out for display.

—AND AT FAIR OAKS

IT comes as a pleasant contrast, half-way through a season of mammoth air pageants, to attend a small, friendly display of the type staged at Fair Oaks on July 3rd. A group of amateur pilots, with some professional assistance, setting out to entertain a crowd of 5,000 or so with light aeroplanes—these are ingredients which keep the atmosphere of pleasure flying unchanged.

An unexpected pleasure at Fair Oaks was the arrival, from Beauvais, of three Jodel D-9s. In the bumpy air beneath grey clouds their formation flying was not especially tight; nor was their fly-past loud or speedy, but the crowd loved these chirpy single-seaters and club members envied their pilots.

With the fairly recent addition of the Vickers (Weybridge) Flying Club, the Fair Oaks club is today very much of a going concern; paid flying hours last month totalled 600, and the prospect of low-rate pilot-training appealed so much to Vickers employees that the 60 members had to be chosen by ballot. Also resident at Fair Oaks is the London Transport Flying Club, whose pilots joined in the Tiger Moth formation to make it a three-club event. After a circus of typical club and private-owner types, instructor Don Doyle (ex-U.S.N.) aerobatted a Tiger Moth in dashing style, and, at still lower levels, Mr. Richard Fairey provided first-rate helicopter entertainment in his personal S-51.

The long-suffering Tiger Moth was put to its sternest test by the Fair Oaks C.F.I., W/C. Cyril Arthur, in the rôle of the "runaway pupil"; parachutist Arthur Harrison demonstrated the locally made G.Q. "blank-gore" canopy with a perfectly controlled and positioned descent; and three Austers "bombed" with flour-bags a mobile target. The programme ended, as it had begun, on an international note, with a finely performed demonstration of sailplane aerobatics by Lt. Staafi, Royal Swedish Air Force, in the Empire Test Pilots' School's blue Olympia.

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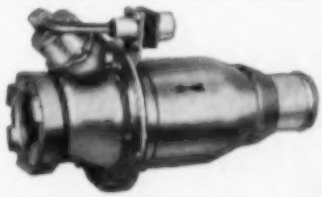

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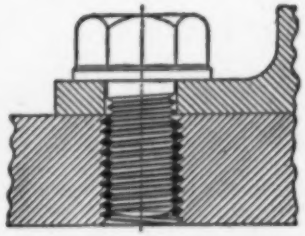

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PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:

FROM Dan-Air Services, Ltd., of Bilbao House, 36/38, New Broad Street, London, E.C.2, for the following Inclusive Tour Services to be operated with Dakota aircraft for the carriage of passengers and supplementary freight in conjunction with Mercury Travel Ltd. at a frequency of from one to two return flights weekly in each case during the season May to September inclusive for a period of seven years commencing 1st May, 1956:

APPLICATION No. 518: For a service between London (Blackbushe) and Palma.

APPLICATION No. 519: For a service between London (Blackbushe) and Nice.

(*Continued in column 2, page 41*)

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PUBLIC ANNOUNCEMENTS

(*Continued from column 3, page 40*)

APPLICATION No. 520: For a service between London (Blackbushe) and Innsbruck.

APPLICATION No. 521: For a service between London (Blackbushe) and Ajaccio.

APPLICATION No. 522: For a service between London (Blackbushe) and Trieste.

APPLICATION No. 523: For a service between London (Blackbushe) and Klagenfurt.

APPLICATION No. 524: For a service between London (Blackbushe) and Perpignan.

APPLICATION No. 525: For a service between London (Blackbushe) and Barcelona.

APPLICATION No. 526: From Transair Ltd., of Croydon Airport, Surrey, for an Inclusive Tour Service to be operated with Dakota aircraft in conjunction with Sky Tourist Services Ltd., for the carriage of passengers between London (Croydon/Gatwick) and Turin at a frequency of two return flights per week during the season from May to October inclusive each year, for a period of five years commencing 1st May, 1956.

APPLICATION No. 527: From Eagle Aviation Ltd., of 29, Clarges Street, London, W.1, for a Seasonal Inclusive Tour Service with Viking and Dakota aircraft in conjunction with Trans Continental Travel Agency, Jersey, for the carriage of passengers and supplementary freight between London (Blackbushe) and Jersey at a frequency of up to four services daily during the season from April to October inclusive, each year, for a period of seven years commencing 1st April, 1956.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3, Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections.

THE Air Transport Advisory Council also give notice that the following applications have now been withdrawn:

APPLICATIONS Nos. 496 and 499, from Transair Ltd., of Croydon Airport, Surrey, for Inclusive Tour Services in conjunction with Sky Tourist Services Ltd., between London (Croydon/Gatwick) and Stavanger and Biarritz, respectively, which were advertised in "The Times," "The Aeroplane" and "Flight" on 24th June, 1955. [3987

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(4) Detail Fitters.

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(2) C Licensed Engineers with C licence on Dart engine.

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The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

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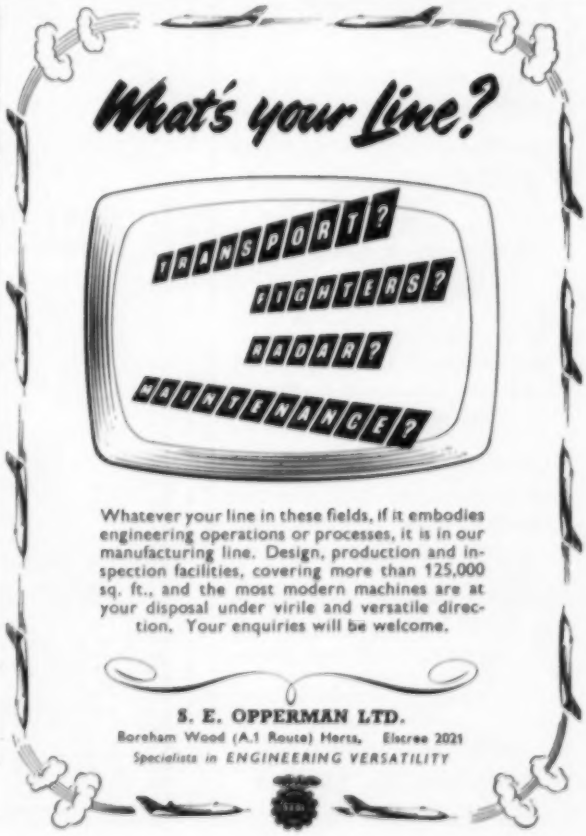

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FOR Stansted:

PERSONNEL Manager, Skyways, Ltd., Stansted Airport, Essex. [3969

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AN editorial assistant required by international aviation publishers in Geneva, Switzerland. Qualifications: English mother tongue, journalistic experience (news editing), working knowledge of French and German, preferably some degree of familiarity with aviation. Age 23-35. Write with full particulars of education and experience, photograph, salary required, to Interavia (U.K.), Ltd., 14, Clarges Street, London, W.1. [3973

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LOUIS NEWMARK, LTD., have vacancies in their laboratories for Physicists and Electro-mechanical Engineers for development work on aircraft and allied instruments. Applications are invited from persons with a degree or similar qualifications who have had some industrial experience preferably on work with gyroscopes, accelerometers or optics. Good salary and prospects. Apply: Personnel Manager, Louis Newmark, Ltd., Prefect Works, Purley Way, Croydon, Surrey. [3983

BRITISH OVERSEAS AIRWAYS CORPORATION have vacancies with various of their associated and subsidiary companies, for pilots. Applicants should have Airline Pilot's Licence with Instrument Rating would be acceptable for the filling of First Officer vacancies. Experience on Dakota, Viking, Dove a desired qualification. Salary rates are very good but vary according to the geographical position of the company concerned. Applications in writing to Staff Manager, Subsidiaries, B.O.A.C., Airways House, Great West Road, Brentford, Middlesex. [3933

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— VACANCY —

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Engineering Manager,
Central African Airways Corporation,
P.O. Box 1979,
Salisbury, Southern Rhodesia,

and should reach the above not later than 31st August, 1955.

SITUATIONS VACANT

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ALL applicants should possess H.N.C. or equivalent. Pension and insurance scheme. Within easy reach of Bournemouth. Special transport facilities. Apply in writing to Personnel Manager, Flight Refuelling, Ltd., Tarrant Rushton Airfield, Nr. Blandford, Dorset. [3966

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DESIGN ENGINEERS, H.N.C. or equivalent preferred. Good engineering knowledge for development of Aircraft Wheels and Brakes, Associated Hydraulic systems, to meet expanding programme. Also TECHNICAL WRITER/INSTALLATION ENGINEER. Pension Scheme. Excellent opportunities for advancement. Written application to the Personnel Manager, Goodyear Tyre and Rubber Co. (G.B.) Ltd., Birkenhead Rd., Wallasey. [3926

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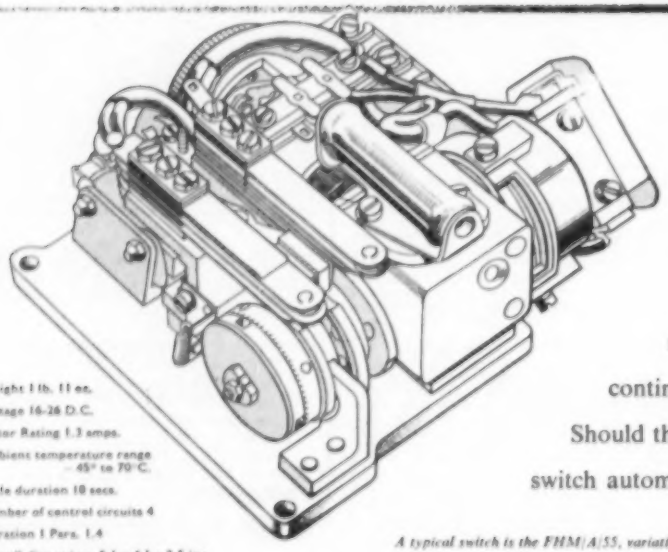

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